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# Engineering and Mining Journal

McGraw-Hill Co., Inc. Price 20c. New York, March 29, 1919

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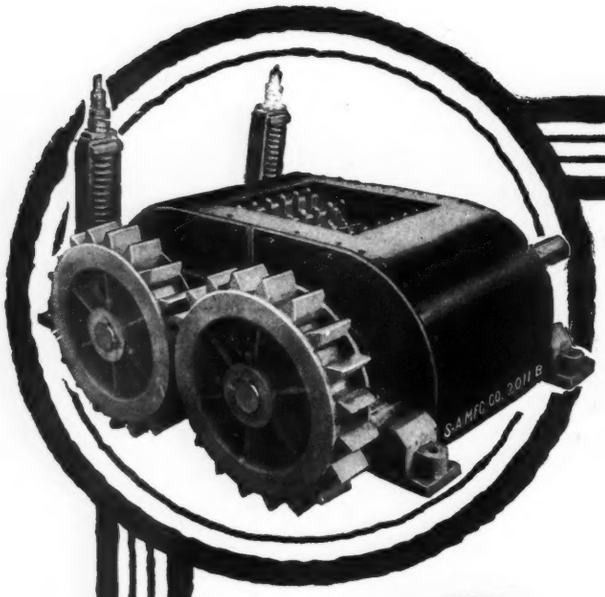


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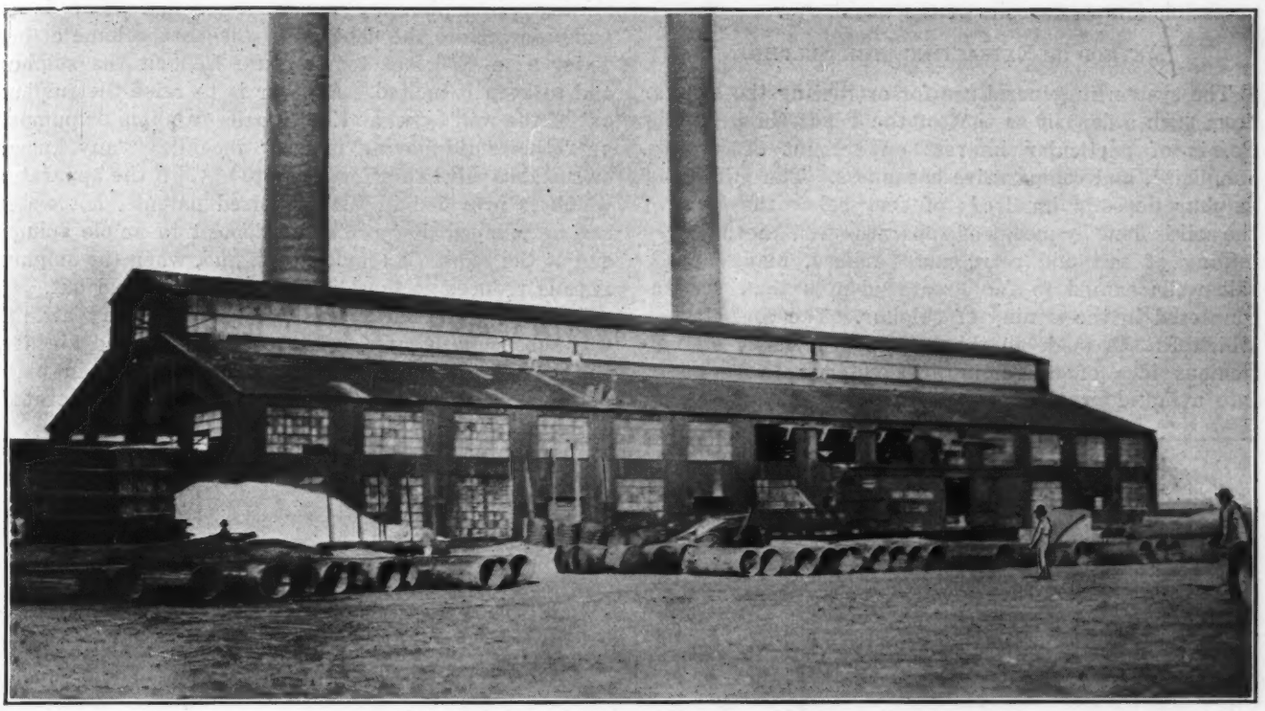
*Volume* 107 *Number* 13

THE STEAMING PLANT BUILDING OF THE TEXAS GULF SULPHUR COMPANY

# Operations and Properties of the Texas Gulf Sulphur Company


*The sulphur deposits near the Texas coast are among the most important sources of this element. The exploitation of such deposits has been made feasible by the Frasch invention by which the sulphur is melted in situ and then pumped to the surface. Owing to the seepage of water and local collapses of ground as the sulphur is withdrawn, the operation increases in uncertainty as exploitation proceeds. The deposit described possesses several favorable features, and it is expected that an output of 1000 tons a day can be maintained when the equipment is in operation. Systematic drilling has indicated the presence of reserves of more than 10,000,000 tons.*

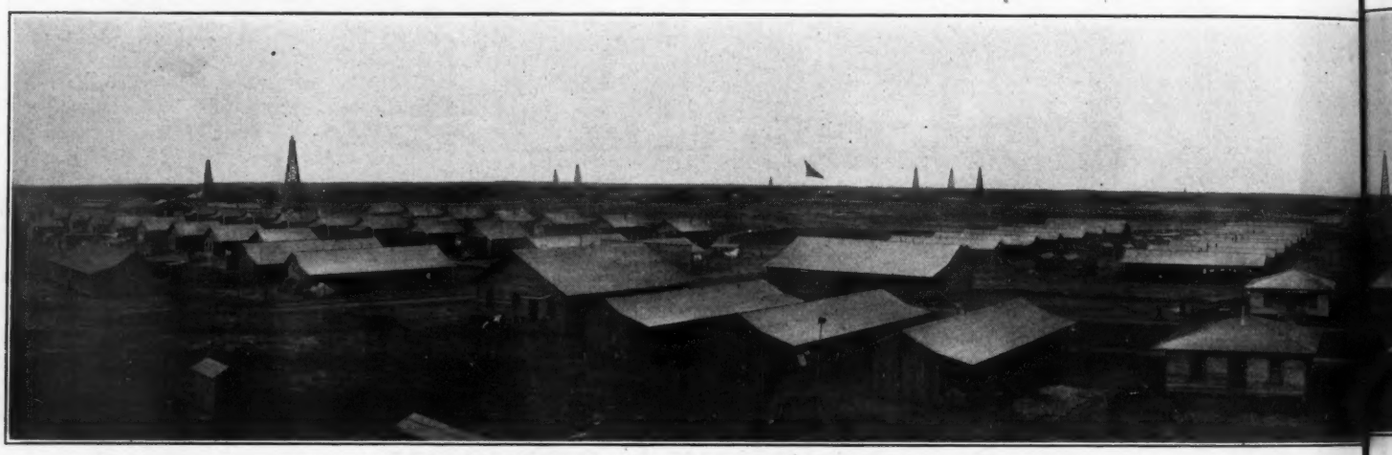

THE sulphur deposits on the property of the Texas Gulf Sulphur Co., at Matagorda, Tex., are found at a depth varying from 800 to 1000 ft. The property is situated about 80 miles from Galveston and one mile from the coast, and is served by a branch of the Santa Fé Ry. The Gulf Coast region is noteworthy for the occurrence of domes of very slight elevation. These marked the spots where sulphur was encountered in a few instances when drilling for oil was in progress. The Matagorda dome is the center of the Texas Gulf Co.'s deposit and has a diameter of about 4000 ft. The sulphur occurs in an almost flat stratum, above which there is an unconsolidated sediment consisting of bands of shale, gumbo, and boulders. On the sides of the dome the dip becomes steep, over 45°, and the sulphur horizon thins out. The general shape is like a flat-topped umbrella. The flatness of the sulphur deposit is noticeable in view of the disturbed condition of the overlying strata, the conformation being favorable for economical removal of the product.

The various bore holes have demonstrated that there is no correlation in the matter of the deposition of the respective strata. Gumbo, shale, boulders, and limestone occur unexpectedly and in widely differing sequence. The formation of sulphur is occurring at the present time, this fact being proved by the discovery of deposits on straw used for plugging.

A stratum of salt and gypsum is found underneath the sulphur, then a layer of salt of undetermined but considerable thickness. The sulphur content of the deposit is fairly uniform, although generally one side of the dome is lower in grade than the remainder. The bore holes have, however, demonstrated that the reserves, as at present surveyed, contain over 10,000,000 tons of sulphur, thus constituting the largest of the accessible known deposits of the world.

### Method of Extracting the Sulphur

The system in general use for extracting the sulphur from such a deposit as that of the Texas Gulf Sulphur Co. is of particular interest on account of novelty, simplicity, and comparative cheapness. The mining of sulphur deposits hundreds of feet below the level of the soil is done by means of apparatus well known in the mining of salt and petroleum. Indeed, many of the salt wells extend to far greater depths than are encountered in the mining of sulphur. The contribution which Frasch made to the art was the novel and ingenious idea of converting the sulphur to be mined into a liquid by melting it with hot water. When so melted it could, of course, be pumped to the surface in any usual and familiar way.



THE PROPERTIES OF THE TEXAS GULF SULPHUR CO.

Patents were issued to Frasch in 1891, according to which a well is bored from the surface of the dome to the sulphur deposit, "as usual in making salt and oil wells." In this well a casing is inserted, for which a diameter of 10 in. is suggested. Within the 10-in. casing, concentric pipe, for which a diameter of 5 in. is suggested, reaches to the bottom of the well. The patents state that the 10-in. pipe may be stopped at the caprock or be extended down into the mine, and that the 5-in. pipe may be provided with perforations at the side, or otherwise be "provided with a strainer." The patents further describe the heating of the water and forcing it into the mine at a suitable temperature sufficiently above the melting point of sulphur to be effective when it reached the sulphur deposit, and, accordingly, to melt the sulphur and reduce it to a fluid. Both the 10-in. pipe and the 5-in. pipe are described as connected with the heater, so that the hot water may pass down through either of them. The hot water might be forced down the outer pipe under such pressure as to force the melted sulphur up the inner pipe to the surface, or "the liquefied sulphur need not be forced up by the heat-conveying liquid, but might be pumped up in any ordinary or suitable way."

The Frasch patents, after running their full course of 17 years, expired in 1908. The process and apparatus which they covered then became public property under the provisions of the patent law. There are, in fact, only two fundamental requirements for the mining of sulphur by hot-water fusion. One is to pump down into the deposit an adequate volume of hot water at a sufficient temperature to melt the sulphur and to keep it melted. Another is to raise the sulphur out of the well by what Frasch calls "a pump or pumps" or "other fluid-moving means," including "any known or suitable substitute for a pump." With the apparatus which is provided in these expired patents, hot water can be pumped down into the deposit in ample volume and at the requisite temperature, and, when the sulphur is thus reduced to liquidity, it can be pumped out.

Instead of the sucker-rod pump an ordinary air lift was subsequently used. It was a second-hand air lift, bought for the purpose, and, when inserted in place of the sucker-rod and its various adjuncts, it operated, as might have been expected, without a hitch. Whether the sucker-rod pump was used or the air lift, the mode of operation was necessarily the same, in that in both cases the hot water forced into the sulphur deposit melted the sulphur, and the pumping devices (i.e., the sucker-rod pump or the air lift—both of which were common expedients for raising liquids from great depths in the mining industry) raised the liquid sulphur to the surface.

Almost at the end of the term of the expired Frasch patents, the Patent Office nevertheless issued additional patents to Frasch, assuming to give him a monopoly of the use of an air lift as the means of raising the melted sulphur from the deposit; but an appeal in the case of the Union Sulphur Co., *vs.* the Freeport Texas Co., in the U. S. Circuit Court, sitting at Philadelphia, has resulted in a decision which insists that the patent in question lacks the essentials of an invention. The use of an air lift, therefore, involves no infringement.

If the sulphur is melted at the proper temperature to bring it to the necessary liquidity, which is wholly a question of supplying it with hot water in sufficient volume heated to the appropriate degree, it may then

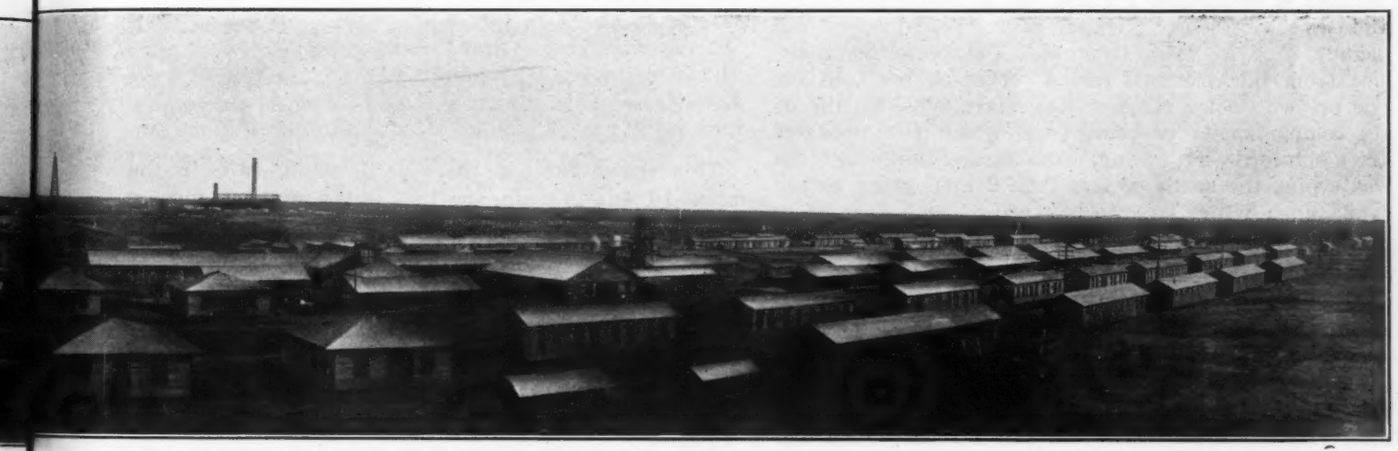
be raised from the well, by any appropriate pump, including the air lift, which for many years prior to its use by Frasch had been similarly employed for raising all kinds of liquids from deep wells.

The mining method is peculiarly effective in that a refined product is delivered at the surface. No further purification is needed, the sulphur being of the highest quality, and with less than 0.5% of foreign constituents. The Texas Gulf deposit contains no deleterious elements, such as arsenic, with the result that a high-grade product is obtainable by following simple operating methods.

The molten sulphur flows to an inclosure, where it hardens. Boards are placed to maintain the shape of the accumulation, which may be of any size desired. There is no deterioration and no limit to such a method of storage. After being broken up as required, it is loaded by steam shovel into railroad cars.

The fuel efficiency of the system is, at best, low and seldom exceeds 3%. Extensive seepage of hot water occurs, particularly as the exhaustion of the deposit continues, with the result that a reliable and ample water supply is a necessity. The Texas Gulf Sulphur Co. is particularly well situated in this respect; and, in addition to a satisfactory water supply, both from wells and the Colorado River, possesses a reservoir with a capacity of 250,000,000 gal. It is believed that the water consumption will average from 2000 to 4000 gal. for every ton of sulphur recovered. A quantity of water at a comparatively high temperature is "bled" through drill holes to the surface, but it has been found impracticable to utilize it or recover any proportion of the heat units contained. As some lime and gypsum are dissolved in the water during its underground peregrinations, it can only be run to waste.

The Texas Gulf Sulphur Co.'s boiler plant consists of 14 Stirling boilers of a total capacity of 10,000 hp. and operating at 125-lb. pressure. Steam from these boilers is used to heat the water pumped underground to melt the sulphur. The buildings are of fireproof construction throughout. Surface and underground tanks are provided for the storage of oil used as boiler fuel, which is procurable locally at a comparatively low cost, or can be obtained from Mexico by steamer. A complete auxiliary equipment is provided, consisting of machine shop, warehouse, and other buildings.



AT MATAGORDA, MATAGORDA COUNTY, TEXAS

## A Large Turbo Blower

At its plant at Copper Cliff, Ontario, the International Nickel Co. has installed what is probably the largest turbo blower yet constructed. Commenting upon this installation, *Iron Age* says:

"The machine is driven by a self-starting synchronous motor, running at a speed of 1500 r.p.m. on 25-cycle, 3-phase, alternating current. The motor is direct-connected to the turbo blower, which is an 8-stage machine with casing completely water jacketed. The blower compresses 42,000 cu.ft. of air per min. to a pressure of 14 lb. per sq.in. The machine is equipped with a constant pressure or volume regulator, which causes the blower to deliver at a constant and adjustable pressure and which may be connected to deliver air at a constant and adjustable volume.

"The exceedingly large size of the blower is due more to the low speed, 1500 r.p.m., than to the power of the machine, and if driven up to a speed for which it is amply strong, it would have 6000- or 7000-hp. capacity. As it is, when running at 1500 r.p.m., the machine absorbs approximately 2500 hp. The shipping weight of the blower is approximately 350,000 pounds.

"With this type of blower construction a stiff shaft is always employed, which never goes through the critical speed, and the impeller blades are mounted directly in 'T' heads machined in the shaft forging. The impeller blades are robust in construction and taper rapidly to the periphery. In addition to the strength which this construction gives, no end thrust is developed within the blower, as there is a complete absence of longitudinal disks, against which any small air pressures could act to create end thrust. The entire impeller is placed with reference to proper clearance to the casing by comparatively small thrust collars carried in one of the supporting journals. The row of large rectangular openings along the side of the blower casing gives access to the water-cooling jacket, which completely encircles the air end casing. The 2000-kw. motor which drives this unit can be started without taking from the line more than approximately its full load kva. rating and requires no auxiliary starting apparatus other than the usual auto transformers and switchboard equipment. Both motor and blower bearings are lubricated with centrifugal oil pumps."

# Metallurgy of the Oklahoma-Kansas District*

By ROBERT W. JOHNSON AND C. E. HEINZ

MILLING methods in the Oklahoma-Kansas section of the Joplin district have been changed and improved from time to time during the history of the field, but as the changes and improvements have been only a gradual growth from the first days of the district to the present time, the authors can attempt to make this paper only a review of the results obtained to date, and from the information thus compiled venture a prediction as to why and how they are subject to improvement.

In a typical mill under present conditions most of the ore is handled under a standard flow sheet. The ore or "dirt" hoisted is sent over a 6-in. grizzly constructed of railroad rails; at this point it is hand culled, the rich boulders being hand broken and dropped into the hopper with the "dirt"; the lean or bare rock being hand trammed and dropped into the waste or boulder pile. From the hopper the "dirt" passes through a Blake-type crusher, set to less than 1½ in., and two sets of rolls—"dirt and return"—and is screened usually to ⅜ in. by a trommel. The complete undersize from this trommel screen serves as the feed for one or two Cooley rougher jigs, Harz type, usually of six compartments or cells, from which two products are obtained—a tailing, deslimed, sent to the waste pile, the sands of less than 2 mm. going to the sand tanks with the overflow water, and a smittem product, which serves as feed for a Cooley cleaner jig, usually of seven compartments or cells. From this cleaner jig the cleaned lead and zinc concentrates go to the bins, and the tailings go to supplementary sand and chat jigs. The middling product of the cleaner, after being crushed, is sent back over the cleaner circuit. The tailings from the sand and chat jigs are sent direct to the sand tanks, the sands from which are screened to 1½ to 2 mm. and distributed to the tables by launders with "pseudo" classifiers.

This standard flow sheet of milling has been altered in some respects in a few of the mills of the district. Some have cut the fines from the coarse at the head of the mill and jigged them separately, with a recrushing of a portion of the larger sizes; others are crushing all the ore to a finer size at the head of the mill and paying more attention to recrushing middlings. Much better systems of dewatering and desliming of tailings are in use, as are also many Dorr thickeners for the saving of fines, in some of the mills being followed by flotation units. Many of the mills have eliminated the classifying launders for the table feed and are using a mechanical distributor; and most of them have ceased to return the enriched cleaner middlings over the cleaner circuit, but, instead, treat the middlings on a separate jig or crush them and send them to the table feed.

Results at the present time can best be exhibited by presenting statistics and analyses showing an average of the entire district. It should be understood that many analyses varied, as two mills almost within a stone's throw of each other may have widely varying ore — one free milling and the other chatty; one extremely leady and the other free from lead; therefore the application of these figures should take this into consideration, as they are an average of the entire district for the last one and one-half years, covering all types of mills and grounds.

TABLE I. AVERAGE ANALYSIS OF ORE (CONCENTRATES) SOLD IN PAST ONE AND ONE-HALF YEARS (MADE FROM OVER TEN THOUSAND CAR SAMPLES)

| | Per Cent. Metallic | Per Cent. Minerals |
|---|---|---|
| Zinc content | 58.60 | 87.90 |
| Iron content | 1.60 | 3.44 |
| Lead content | 1.04 | 1.18 |
| Lime content (CaO) | .90 | 1.72 |
| Acid insoluble (sand) | 5.20 | 5.20 |
| Sulphur | 31.28 | ..... |

TABLE II. AVERAGE ANALYSIS OF COARSE MILL TAILINGS (COVERING NINE-MONTH PERIOD, FIFTY MILLS AND ONE HUNDRED SAMPLES COMPLETELY SCREENED)

| | Per Cent. |
|---|---|
| Zinc blende (ZnS) content | 3.45 |
| Galena (PbS) content | 0.16 |

TABLE III. AVERAGE SCREEN ANALYSIS ON COARSE MILL TAILINGS

| Mesh | Mm. | Per Cent. by Weight | Per Cent. as ZnS |
|---|---|---|---|
| 3—10 | (plus 1.5) | 65.60 | 3.20 |
| 10—48 | (plus 0.29) | 24.50 | 2.40 |
| 48 through | (through 0.29) | 9.90 | 6.20 |

This shows 63% in the plus-10 mesh, 18% in the minus-10 plus-48 mesh, and 19% in the minus-48 mesh.

TABLE IV. AVERAGE ANALYSIS OF ROUGHER TAILINGS

| | Per Cent. |
|---|---|
| Zinc blende (ZnS) content | 3.09 |
| Galena (PbS) content | 0.06 |

TABLE V. AVERAGE SCREEN ANALYSIS OF ROUGHER TAILINGS

| Mesh | Mm. | Per Cent. by Weight | Per Cent. as ZnS |
|---|---|---|---|
| 3—14 | (plus 1.25) | 77.00 | 2.90 |
| 14—48 | (plus 0.29) | 20.40 | 2.30 |
| 48 through | (through 0.60) | 2.60 | 13.10 |

This shows 72% in the plus-14 mesh, 15% in the minus-14 plus-48 mesh, and 13% in the minus-48 mesh.

TABLE VI. AVERAGE ANALYSIS OF SLUDGE OR TABLE TAILINGS

| | Per Cent. |
|---|---|
| Zinc blende (ZnS) content | 4.56 |
| Galena (PbS) content | 0.25 |

TABLE VII. AVERAGE SCREEN ANALYSIS OF SLUDGE OR TABLE TAILINGS

| Mesh | Mm | Per Cent. by Weight | Per Cent. as ZnS |
|---|---|---|---|
| 20—48 | (plus 0.29) | 35.40 | 2.70 |
| 48—100 | (plus 0.14) | 33.20 | 2.20 |
| 100 through | (through 0.14) | 31.40 | 9.40 |

This shows 20% in the plus-48 mesh, 15.3% in the minus-48 plus-100 mesh, and 64.7% in the minus-100 mesh.

TABLE VIII. AVERAGE ANALYSIS OF FLOTATION TAILINGS

| | Per Cent. |
|---|---|
| Zinc blende (ZnS) content | 5.11 |
| Galena (PbS) content | 0.47 |

TABLE IX. AVERAGE SCREEN ANALYSIS OF MILL FEED

| Mesh | Mm. | Per Cent. by Weight |
|---|---|---|
| 0—14 | (plus 1.25) | 75.00 |
| 14—48 | (plus 0.29) | 14.00 |
| 48 through | (through 0.29) | 11.00 |

The above are average results from a number of different mill-cleaner jigs. Many of the different individual results varied greatly.

*Abstracted from the Joplin *Globe*.

The average recovery from the mills of the district is said to be 6%—meaning six tons of concentrates, both blende and galena, are recovered from each 100 tons of "dirt" milled. This average varies, of course, for individual mills, in the ratio that their respective grounds vary from rich to lean or poor.

From the numerous complete screen analyses of mill heads, mill tailings, rougher tailings, sludge or table tailings, flotation tailings, and concentrates, of which the preceding average analyses are a summation, the following pertinent facts concerning mill tonnage have been derived:

Disregarding the concentrates taken out, and also the middlings, smittem, and tailings returned through any circuit, the screen analysis of mill feed, and of mill, sludge, and flotation tailings, shows as follows:

Mill feed average contains 11% of minus-48 mesh material; flotation tailings are 100% minus-48 material; table tailings are 64.9% minus-48 material; mill tailings are 9.9% minus-48 mesh material. Therefore, of the 11% minus-48 mesh material in the feed, flotation tailings are $1.00 \div 174.5 \times 100 \times 11$, or 6.6 parts; table tailings are $0.646 \div 174.5 \times 100 \times 11$, or 4.0 parts; mill tailings are the remainder, or 0.4 parts. Derived in the same way, of the 14% of minus-14 plus-48 mesh material, table tailings are 8.1 parts; mill tailings are 5.9 parts. Of the 75% of plus-14 mesh material, mill tailings are 75 parts. Considering the screen analysis of rougher jig tailings, the mill tailings are split into 58.7 parts rougher and 22.6 parts cleaner.

Summarizing the above, gives the following totals:

| | Per Cent. |
|---|---|
| Rougher tailings | 58.70 |
| Sand or chat jig tailings | 22.60 |
| Table tailings | 12.10 |
| Flotation tailings | 6.60 |

However, since the mill at various points returns smittem, middlings, and tailings, it is necessary to follow the above percentages through the mill flow sheet to attain actual tonnages handled by various units. The rougher jig receives 100% by weight of material. This becomes 55.18% tailings and 44.82% smittem. The latter becomes, on basis of 6% recovery, 4.88% concentrates, 18.70% middlings, and 21.24% tailings. The middlings and tailings become: Sand and chat jig feed, 39.94%; middlings, 5.24%; and table feed, 34.70%. The table feed becomes, considering table and flotation together, on basis of 6% recovery, 29.47% tailings, 4.10% middlings, and 1.13% concentrates.

It is assumed that all jig concentrates come off at cleaner, sand, and chat jigs, and table concentrates at tables; and that all chat jig middlings return to cleaner, and all table middlings return to tables.

Therefore, of each 100 parts of ore entering the mill, the rougher jig handles 100 parts, making 55.18 parts of tailings. Cleaner jig handles 50.00 parts; sand and chat handle 45.18 parts; tables handle 44.04 parts, making 38.82 parts of tailings.

This tonnage includes both new feed and that portion of middlings and tailings returned through various closed circuits. It has also been assumed that no sands were floated off at any jig—that the only fines at those points were those included in the tailings—those which would float off were assumed as going through to the tables, instead of calculating them out to the sand tanks and back again.

Reassembling on the basis of 94 parts of tailings out of each 100 parts of feed:

| | Parts |
|---|---|
| 55.18 parts rougher tailings become | 58.70 |
| 38.82 parts table tailings become | 41.30 |
| Total tailings | 100.00 |

Contents of tailings based on percentages of ZnS and PbS parts:

| | Parts |
|---|---|
| Rougher tailings at 3.15% × 58.7 | 1.85 |
| Table tailings at 4.81% × 41.3 | 1.98 |
| Total | 3.83 |

Of this 3.83% of ZnS and PbS combined as average analysis of tailings, 48.3% are in the rougher tailings alone, and 51.7% are in the sludge or table tailings.

Flotation units as part of the mill flow sheets operate on the sands and slimes received from sand tanks or Dorr thickeners taking jig overflow waters and sand and chat jig and table tailings. In the figures previously given, the equivalents of these fines are those given in Table VII, as no account has been taken of those floated at rougher, cleaner, etc., but they have been considered as going through to the tables.

Sludge tailings are 41.3% of total tailings and are 64.6% flotation feed—that is under minus-48 mesh—which gives 26.67% of total tailings as flotation feed. Average analysis is 5.69%. On 26.67%, this gives 1.50 parts of valuable material. Considering flotation as 70% efficient, 1.05 parts will be recovered, which is 27.4% of the total valuable content in the total tailings. This results in increasing the recovery to 7.05% and reducing tailings average percentage to 2.78.

TABLE X. AVERAGE ANALYSES OF JIG CONCENTRATES FROM NOS. 1, 2, 3, AND 4 ZINC CELLS

| | No. 1 Cell | | | No. 2 Cell | | | No. 3 Cell | | | No. 4 or Last Cell | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mesh | Per Cent. by Weight | Per Cent. Zn | Per Cent. Pb | Per Cent. by Weight | Per Cent. Zn | Per Cent. Pb | Per Cent. by Weight | Per Cent. Zn | Per Cent. Pb | Per Cent. by Weight | Per Cent. Zn | Per Cent. Pb |
| 4 | 2.0 | 62.9 | 0.03 | 0.4 | 63.0 | 0.02 | .... | .... | .... | .... | .... | .... |
| 6 | 12.1 | 62.3 | 0.03 | 6.0 | 63.0 | 0.10 | 2.7 | 62.9 | 0.03 | 0.03 | 57.0 | 0.55 |
| 8 | 21.3 | 62.1 | 0.10 | 10.0 | 63.0 | 0.04 | .1 | 62.7 | 0.03 | 1.7 | 56.0 | 0.42 |
| 10 | 17.0 | 61.3 | 0.16 | 7.9 | 62.6 | 0.02 | .6 | 62.7 | 0.06 | 7.3 | 57.0 | 0.32 |
| 14 | 13.1 | 61.2 | 0.17 | 8.5 | 62.2 | .... | 10.6 | 62.0 | 0.06 | 12.8 | 59.0 | 0.14 |
| 20 | 8.5 | 61.0 | 0.17 | 6.9 | 62.0 | 0.02 | 1.2 | 62.1 | 0.06 | 10.7 | 60.0 | 0.05 |
| 28 | 6.7 | 61.3 | 0.30 | 12.1 | 61.2 | 0.06 | 7.7 | 63.0 | 0.04 | 20.6 | 60.0 | 0.02 |
| 35 | 4.4 | 60.0 | 1.10 | 11.7 | 58.2 | 0.06 | 3.0 | 62.3 | 0.02 | 19.4 | 61.5 | .... |
| 48 | 3.7 | 58.0 | 2.10 | 11.0 | 57.0 | 0.10 | 9.6 | 60.3 | 0.02 | 10.7 | 61.4 | .... |
| 65 | 4.4 | 57.3 | 3.60 | 10.8 | 57.3 | 0.16 | 9.0 | 60.0 | 0.02 | 8.2 | 60.3 | 0.02 |
| 100 | 3.6 | 53.2 | 7.80 | 8.0 | 57.0 | 1.10 | 5.4 | 59.4 | 0.20 | 5.3 | 59.0 | 0.06 |
| 100 | 3.2 | 34.8 | 24.20 | 6.3 | 45.1 | 12.00 | 5.0 | 50.6 | 0.60 | 3.8 | 53.0 | 3.10 |

The information thus assembled shows the following average results of the milling practice of the district:

| | Per Cent. |
|---|---|
| Average metallic contents of ore (concentrates) sold | 58.60 |
| Average recovery, 6.0%, with flotation | 7.05 |
| Average tailings, 3.83%, with flotation | 2.78 |

On these averages, the results show that present milling practice is recovering one ton of ZnS and PbS together out of every 1.64 tons of ZnS and PbS together contained in the original run-of-mine ore. This tonnage of 1.64 in the original ore is based on the assumption that tonnage of concentrates recovered, plus tonnage of valuable material in the tailings figured

from analysis percentage, is not actual tonnage, however, since there is another factor not herein considered—that of the valuable material carried by the excess overflow waters when they are finally released to pond or creek as waste water. Analyses of these show a considerable proportion in slimes which probably approximate 0.1 more tonnage, or 0.06% more total valuable material, which will change the given figures proportionately.

In arriving at the averages presented it has been necessary, owing to the great variation in ore character of many of the mills, to strike a general line. The averages, therefore, are not typical of any one mill, but are for the entire district. The percentage of recovery has been greater than 6 in some of the mills, varying according to the richness of the ground mined.

In what proportion of the tailings does the flotation feed lay? Flotation requires from minus-48 to minus-65-mesh for feed. Mill tailings are 58.7% of total tailings, and contain 2.6% of minus-48 mesh material—1.53 parts of minus-48 mesh. Sludge tailings are 41.3% of total tailings and contain 64.6% of minus-48 mesh material—26.68 parts of minus-48 mesh. The two combined make 28.21% of minus-48 mesh material in the total tailings, with an average analysis of ZnS and PbS of 5.7%. Total valuable matter, therefore, in the flotation material is 1.61 parts, or 42% of the total valuable content of the tailings. If therefore, following the present practice in mills, flotation units at 70% efficiency are put in operation on tailings piles, the recovery is 1.12 parts of 29% of the total valuable contents in the tailing piles. This would increase the total recovery of 7.12%, leaving the tailings still with an average concentrate content of 2.71 per cent.

At present, therefore, there seems to be a line where the limit of flotation is reached. This limit, when flotation is used as a unit of the mill, is the percentage of fines in the ore—when the flotation process is used as individual units on residue tailing piles, it is the problem of separating and recrushing the great excess tonnage of coarser material containing 58% of the valuable matter.

The screens and analysis of cleaner jig cells show another point which also limits flotation, namely, that there is a limit to which fine crushing can be carried unless all present milling methods are discarded and all the ore is sent direct to flotation or screen classification. The analysis shows that under present crushing the presence of fines is already lowering the grade of the ore, as it is those fine particles of possible flotation feed in the concentrates that lower the zinc content and raise the sand content. Instead of increasing fines for the purpose of following up with flotation, it would seem reasonable to reduce or separate the fines. Owing to these three limiting features, flotation seems at present to have a definite place marked out for it to work upon—leaving to some other means the problem of the balance. And the biggest portion of that balance seems to lie in the plus-14 mesh material.

However, with flotation now entering the field to care for a portion of these valuable constituents that operators have neglected, a big forward step has been taken. The other portion of these valuable contents will also eventually be saved. A more careful study of the mill as a whole, as well as of the individual units of it, would make it possible for the jigs, tables, and flotation units to make a higher recovery without radical changes in the mill flow sheet. It needs only the consideration of each mill as a problem by itself successfully to accomplish it.

## Licensing Hoisting Engineers In Nevada*

As a result of years of experience I am convinced that fewer accidents will occur if hoisting engineers are required to obtain licenses which mean something, and when once issued carry the dignity and recommendation that a man is a first-class mechanic in so far as the operation of a hoist is concerned. The majority of hoisting engineers with whom I have discussed the matter are in favor of such a law. In nearly every walk of life where the lives of men are entrusted to a single individual, such as a railroad engineer or a steamship pilot, standards of qualification are prescribed, and credentials are required before such men are entrusted with the lives of their fellows.

It is my recommendation that all hoisting engineers who are required to hoist men be compelled to obtain licenses before undertaking such work, and that operators be prohibited from employing men in such capacity unless a license is exhibited. The licenses should be issued, without limit as to number, by a board, which shall examine the applicants in detail and give practical tests before passing upon the qualifications. The board should be composed of a technical man, a practical man, and at least one other conversant with mining. Such a law can be put into effect without great expense and without unduly upsetting the existing scheme of affairs of the present operating engineers.

Provision can be made for the issuance of temporary licenses upon practical tests in the event of emergency, so as not to work a hardship upon the men who must earn a living that way, or upon the operators who may at times require the service of a hoisting engineer in an emergency. However, this would be only at the beginning of the working of the act, for in a short time all engineers would provide themselves with licenses. Doctors, dentists, and others are subject to the test before beginning practice, and must await the issuance of licenses, and I feel that there would be no great hardship encountered among the miners because of such a requirement.

## New Shaft-Sinking Record

A new world's record in shaft sinking was obtained in December, 1918, at the Crown Mines, Johannesburg, South Africa. The shaft at which the record was made is circular, having a diameter of 20 ft. inside the walling, and during December was sunk 279 ft., or from a depth of 655 to 934 ft., the average speed being nine feet in 24 hours. The cost of sinking, exclusive of walling, was between £13 and £14 per ft. during the month.

The previous world's record was also held at the Crown Mines, where 252 ft. was made in a 31-day month at the No. 14 circular shaft of the mines; this was also a 20-ft. shaft. R. C. Warriner, 120 Broadway, New York, was consulting engineer at the Crown Mines up to the end of 1918.

*Abstracted from the Biennial Report, 1917-1918, of A. J. Stinson, State Inspector of Mines of Nevada.

# Steam Economics in Simple Terms

BY S. A. WORCESTER*

*Discussion of several of the most prevalent wastes in steam-boiler and engine plants, so that managers or men in charge of properties, who have made no thorough study of steam-plant economics, may have brought to their attention possibilities for substantial savings in fuel costs. The simplest remedies for preventing waste are indicated in non-technical terms and are usually merely matters of proper adjustment and operation.*

ONE of the wastes that are obvious to the trained engineer is the result that comes from the use of a boiler pressure too low for economy. The economy of the higher pressure depends on the fact that about as much fuel is burned in generating 1 lb. of steam at 1 lb. pressure as the additional fuel needed to raise this pressure to 100 lb. The given weight of steam will do about 100 times as much work at 100 lb. as at 1-lb. pressure, though requiring only twice as much fuel for its generation. Early in the history of the steam engine, the usual boiler pressures were below 5 lb. per sq.in., and the greater part of the work of the engine was done by atmospheric pressure on the piston, and was made effective by the vacuum produced at the opposite side by condensing the steam. Boiler explosions are recorded at these crude plants with pressures as low as 10 or 15 lb. per square inch.

## THE ADVANTAGES OF HIGH-PRESSURE STEAM

Since the economy possible with higher pressures was learned, and materials and mechanical construction of boilers and engines were improved, steam pressures have gradually risen so that comparatively few plants of importance now use less than 150-lb. boiler pressure. and recently constructed plants carry as much as 250 lb. per square inch.

The value of higher pressure steam was impressed on me early in my apprenticeship as a machinist by an interesting experience. I was engineer and fireman for a plant of 20 nominal hp., doing usually about 10 hp. work when running only the machine shop, but using 20 hp. for a period of three hours twice a week, when it was necessary to run the foundry cupola blower at casting time. The first two days I had no difficulty in making steam for the light load, but on the third day, when the blower was started, I fell into trouble. Having had no warning of the extra demand for steam, I was not prepared and was carrying the usual boiler pressure of 45 lb. When the blower was started, the extra load soon began to pull the steam down. The coal was rather dirty and fine, and my experience in firing limited, so I put in lots of coal and stirred it often. Soon the foundry foreman appeared to inquire why the blower was running so slowly. The rest of the afternoon passed with a succession of vigorous stirrings and attempts to get more fuel into the fire box, and several unpleasant visits from the foundry men helped to keep me bathed in perspiration, and the steam kept going lower and the engine running slower until the heat was over. The next day, a machinist who had served his apprenticeship in the same shop told me of a similar experience with the same plant, and advised me, when taking on the heavier load, to have about 85-lb. boiler pressure at the start and a clean fire of coarse coal. The steam pressure should be watched closely and not allowed to fall much below 80 lb., he said. To do this I would have to partly close the drafts at times to prevent wasting steam at the safety valve, and there would be no trouble in making steam to carry the full load. He said, further, that the pressure must not get below 75 lb., or it would be impossible to get it up again with the heavy load on. I followed his instructions the next time the blower was used, and had no difficulty in keeping the fan up to top speed, proving to my satisfaction that the same plant which would not make steam to carry a certain load at 40-lb. pressure would make plenty of steam at 80 lb. to do the work.

## FUEL CONSUMPTION NOT LESSENED BY LOW STEAM PRESSURE

Some years later, at a large smeltery at Monterey, Mexico, I found several Mexicans energetically trying to keep steam with a battery of modern boilers at 25-lb. pressure for a 250-hp. Corliss engine, the plant being designed for at least 125-lb. pressure. This could not have been the usual condition at the plant, because the engine was running at less than half its proper speed. If, however, someone in charge had known the importance of higher steam pressure, much labor and fuel would have been saved, and the engine could have been kept up to its speed.

It is a common idea among non-technical men that the lower the steam pressure can be kept, and still maintain the engine speed, the less the fuel consumption. A brief study of the steam tables and other information found in mechanical engineers' handbooks will make evident the economy of the higher pressures.

## STEAM EXPANSION AND ADJUSTMENT OF ENGINE VALVE GEAR

The expansive use of steam in the engine cylinder and proper adjustment of the engine valve gear are matters of considerable importance in plants of any size and should be better understood by the average engineer. To illustrate the difference between expansive and throttling use of steam, suppose that the speed of an engine is controlled by admitting steam to the cylinder through a throttle valve during the whole stroke of the piston. Let the boiler pressure be 100 lb., and partly close the throttle so that the average pressure on the piston will be 25 lb. throughout its stroke.

Assuming the content of volume of the cylinder is 4 cu. ft., 1 cu.ft. of steam at 100 lb. will be required to maintain a pressure of 25 lb. for one piston stroke. Comparing this with the expansive use of 1 cu.ft. of

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steam at 100 lb. pressure, let the full boiler pressure be admitted to the cylinder by a wide-open throttle until the piston has made one-quarter stroke, using 1 cu.ft. of steam. At this point cut off the steam admission, using Corliss or other cut-off valve gear, and admit no more steam during this stroke. Then, as the piston travels the steam expands, filling the enlarging space, and its pressure decreases in inverse proportion to the increase in space or volume, so that at one-half piston stroke the pressure is 50 lb.; at three-quarter stroke, 33⅓ lb. and at full stroke, 25 lb. Taking an average of the four pressures, the result is 52½-lb. "mean effective pressure," as compared with the 25 lb. from the same quantity of steam by throttling.

Many engines run on loads so light that they cut off at one-quarter stroke or earlier, and give high expansion. Several years ago I found an ore-mill engine running regularly with a load so light that it showed, by indicator diagrams, a cut-off at less than one-tenth stroke, the steam being admitted to the cylinder at 150 lb. pressure and expanded to less than 15 lb. at the point of exhaust.

### Hand-Operated Cut-Offs and Valves

Some steam engines, particularly air compressors and pumping engines, have cut-off valves made so that they may be adjusted by hand, and the steam economy of these plants depends largely on the care with which the engineer maintains the cut-off at the earliest practicable point. I once found a steam-driven air compressor at a gold mine operated by throttling control, although it had hand-adjusted cut-off valve gear. The cut-off adjustment was out of repair, and as none of those in charge knew its usefulness or importance, it was out of use. I guaranteed a 10% saving in steam and fuel if allowed to do, at my own expense, some work on the steam plant, not specifying the exact nature of the work, but agreeing not to interrupt the regular operations, and my compensation was to be a percentage of the saving accomplished. By merely making the trifling repair necessary to the cut-off adjustment, and instructing the engineer to run with the throttle wide open, regulate the speed by using the cut-off adjustment, and keep the boiler pressure uniformly high, I effected a 25% saving in fuel and was paid on that basis and thanked for my services. At another air-compressing plant operating under better conditions I saved 5% of a $1200 monthly coal bill by merely changing the adjustment from throttling regulation to governing by cut-off with a wide-open throttle.

### Proper Adjustment of Automatic Cut-Offs Necessary

The majority of stationary engines of considerable size now govern their speed by using some form of automatic cut-off valve gear; that is, the valves cut off the steam early or late in the piston stroke, accordingly as the load on the engine is light or heavy. The point of cut-off is regulated automatically by a speed governor. At one steam plant which included a large cross-compound, steam-driven air-compressor, with Corliss automatic cut-off valve gear, the monthly coal bill exceeded $2400. By simply adjusting the cut-off mechanism so as to make it operative, a saving of 5% was made in the fuel bill. The master machanic, a man of experience but of no technical education, found it sometimes easier to start the compressor with the low-pressure valves not cutting off, so he left the cut-off inoperative at all times, thereby wasting fuel which cost at least $120 per month, to say nothing of the waste of water.

### Noisy Exhaust Usually Indicates Waste

A practiced, observant engineer can usually tell, from the appearance and sound of the exhaust of a non-condensing engine, whether it is working economically or not. It may be assumed as a general rule in most cases that, when the exhaust is loud, steam at a pressure sufficient for considerable work is being wasted. If the noise is a succession of short, sharp coughs, quite distinct, with no roaring or hissing sound continuing between the puffs, steam is being exhausted before it has expanded to an economically low pressure.

If the engine will carry its load with an earlier cut-off, this may be the remedy. Perhaps a higher boiler pressure is allowable and necessary to make the engine carry its load with expansive use of steam. In some cases where a belted engine is running too slowly to carry its load with an early cut-off, the sizes of pulleys may be changed and the engine run at higher speed. If the engine is running near or at the practical speed limit, and so loaded that it will not maintain speed without the highest allowable initial pressure and a late cut-off, the only remedy is a larger engine.

### Condition of Pipe Often Causes Contracted Exhaust

A continuous, roaring exhaust, without distinct puffs or coughs for each emission of steam, usually indicates either leakage in piston or valves or unduly contracted places in the exhaust pipe or connections. Leakage can be distinguished from a contracted exhaust by listening at the exhaust when the engine is first started from rest, at which time the hissing or roaring noise will be noticeably different from the cough of the exhaust. Contracted exhaust is most noticeable when the engine is running at full speed and load. In some cases the exhaust pipe is too small and in others it is unduly contracted at some turn, or perhaps at its end. Occasionally an exhaust is found passing through a feed-water heater with tubes too small to afford a free passage. I once found a Corliss engine operating against a back pressure of 7 lb. caused by a feed-water heater having very small tubes and preventing free escape of the exhaust.

I lived for several years within sight and sound of one of the largest steam-operated mining plants in Colorado, which included a direct-acting hoisting engine and a large cross-compound, steam-driven air compressor, both having Corliss valve gear and capable of high economy. Although in charge of well-paid managers and master mechanics, these engines have continued for years to exhaust with noise often audible at a distance of a mile or more. When the manager was once approached by a consulting engineer of broad experience with a proposal to adjust the plant so as to make a handsome saving of fuel, and asking a contingent fee of a small percentage of the saving effected, he was met with the statement that such work might antagonize the master mechanic; hence it could not be considered. The waste still continues.

At one time the engine furnishing the power for a Montana planing mill was leaking badly through the piston rings, as I judged from the sound of its exhaust. To make sufficient steam it was necessary to burn considerable coal, as well as all of the shavings and scraps made by the mill. After I had rebored the cylinder and fitted new piston rings to stop the leakage, the boiler not only required no coal but consumed only part of the mill shavings, so that the plant had shavings for sale. The repair repaid its cost in a few weeks.

## News From Paris

By Mark R. Lamb

Paris is full of people. Besides the Peace Commission, there are the men from the American-British armies, the Red Cross, the Y. M. C. A., and nearly a score more organizations. There are 1600 Red Cross people here ready to go home, and no steamer space.

The soldier boy with 10 days' leave generally overstays a few days, and that helps increase congestion. Today 300 new, zealous, extra military police are stopping all our men and officers and examining papers. The results are surprising, and quite a few men will return promptly to where they belong. Hotels are full. Lodging houses have been full for a long time. Private families do not like the idea of renting rooms or providing board, even when good prices could be obtained. The result is that the French consuls have been advised that no more people are desired in Paris. Those of us who saw no war, and who did not suffer, are inclined to wonder why things do not get down to a peace basis more quickly. Ordinarily, what a city wants is visitors, but here is Paris imploring the visitor to stay away, and actually trying not to receive him for another six months. An American company with headquarters in London has been trying for three months to get its employees here to a branch office.

Good business will be done here—much more than before the war. The country is starved for good things to eat and wear. I tried to buy some dresses for my little girl, but the merchant advised me first to ship the silk and dyes to France. No silk has come here for years, and the dyes available are not of the best. No one, however, will succeed in replacing the art and craft of the Frenchman in building gowns, and so he ought to be supplied with the materials. The railways are said to be in bad condition, but to me the rails I have seen and ridden over seem good enough. There is a shortage of locomotives and cars, but the Boche is kindly sending these over at top speed, and France will soon have all she needs. The American Army will have much rolling stock to sell, and France cannot afford to let England or Germany or Russia buy it.

The rivers are normal again, and traffic has begun. It requires only five or six days by canal from Havre to Paris; and now that French steamers are sailing from that port, transportation to the capital will be measurably improved. The Reconstruction Commission is busy around Lille, and, to begin with, has bought all brick and similar construction material in sight.

The French nation looks askance at the combines being formed in the United States. An example of this is the combination of the manufacturers of sugar machinery, formed by one of the large New York banks. It is not difficult for the French manufacturer of this class of machinery to visualize the destruction of his business. Even with a 60% import duty on autos, the local manufacturer finds food for thought in the recent news of the combinations planned to "dump" in Europe. If, therefore, it seems that France is not eager to welcome *every* American company or business man or bank, it must not be considered an affront nor taken too seriously, nor considered as an unfriendly act. Keen competition must be expected.

One thing is certain. Food will be welcome for a long time and in any quantity that can be imported. Four very ordinary apples cost $3.20. At that rate a real Oregon apple would sell for $1. Butter is $4 a pound, but none is served at the hotels. Perhaps the newly released German ships will better this situation. It must be plain, however, that until food costs are brought down at least to American levels, Europe cannot be expected to offer a very attractive market to America; and those terriers in Washington who are barking at Hoover should be reprimanded by the business people as quickly as possible.

A snowstorm and a subway, surface car and bus strike occurred simultaneously in Paris recently, the result being astonishing. The sidewalks were congested with people. Fortunately the distances are not great, and, also fortunately, the strike lasted only one day. The surface cars and busses have an interesting way of determining priority when the crowd exceeds the capacity of the car. The passenger, on arrival at the station, takes a numbered ticket from a rack. This ticket is intended to obviate the necessity for standing in line, as the conductor calls the numbers, and the respective passengers step aboard as their numbers are called. How would that system work on the New York subway or on the "L"?

The hotels here, even with the diplomats out of the way (and they will be here for years) are wholly inadequate. Of course no new ones are being built. At best, some old buildings are being remodeled and used as annexes to present hotels. M. René Werthemie has just purchased a five-story building which was begun before the war and is not yet completed. It is to be made into a modern office building, but it will be several months before it is complete. It will surely be filled immediately, as offices are extremely scarce and unsatisfactory. Paris surely needs food and hotels and office buildings.

Beginning on Feb. 1, one will be permitted to have and to use a registered cable address. This is a great improvement, as it means an economy in every cable dispatch. Business cables arrive promptly from the United States and are slightly delayed returning from here. It would be a great help if Mr. Burleson would have the cable companies indicate date of transmission on the cable itself. This is done by the French and English postoffices through which cables are sent. The delay is less important if one knows its extent. As late as the beginning of January it was necessary to show one's passport in sending cables. Now this is not demanded in every case, which indicates a relaxation in the rules.

After being closed for five years, the famous, gorgeous restaurant of the Grand Hotel was opened recently. You New Yorkers who like to loaf in Paris will know what that means and what a throng was there—diamonds and pearls, paint and powder, gold-lace uniforms and plain American khaki mixed with a confusion of laughter and tinkling glasses. Paris is not dry—positively!

# The Rise in Cost of Zinc Mining in Wisconsin

By W. F. BOERICKE*

*A comparison of costs of mining and milling zinc ores in Wisconsin in 1918 with similar operating expense in 1914. A constant tonnage has been assumed, and on this basis the variation in cost of the different items involved has been considered. The analysis permits a detailed study of the problems which have arisen; and the author of the paper classifies and discusses possible developments which would insure a continuance of mining operations in the district and the future prosperity of the zinc-mining industry.*

THIS article has been prepared in an effort to obtain definite figures to denote the ratio of increase in the cost of zinc mining in Wisconsin between January, 1914, and December, 1918, or, in other words, to record the increase in costs between the prewar period and the signing of the armistice. It is obvious, upon reflection, that no correct ratio can be obtained by comparing *per-ton costs* of 1914 with those of 1918. As costs are dependent on tonnage hoisted, other things being equal, the consequent variations will depend entirely on the condition of the mine, the efficiency of the labor, and the ability of the management. It would be possible to operate at much lower costs in 1918 than in 1914, in spite of higher wages and prices of supplies, if the tonnage had been increased largely by improved conditions in the mine during this period and by the substitution of labor-saving machinery and cost-reducing appliances under a progressive management. On the other hand, if the case be reversed, it might have been good policy to try selective mining, with a decrease in tonnage, which would show an increase in cost out of all proportion to the actual rise.

## Cost Comparison Possible by Assuming Fixed Tonnage

It follows, therefore, that, to ascertain the precise ratio of the increase in mining costs, it is necessary to assume a constant tonnage, and to investigate the increase in the separate elements that enter into the cost of mining. This comparison appropriately may be made on the figures for 1914, as related to those of 1918. A true ratio of increase of such items will then be available, assuming that all conditions of mining, and the efficiency of labor and management, have remained constant.

It may be objected that it is not fair to make this assumption, because, in all successful enterprises, there is, or should be, an increasing efficiency of labor and management that tends to lower costs every year. To this objection the reply can be made that the purpose here is to inquire solely into the rise in operating expense that has entered into nearly every element of mining. Such an increase has been largely beyond the power of the individual to influence one way or the other; and it may be left to the manager to determine whether the increased efficiency of his mine and methods has compensated for that rise.

Considered from another angle, it may be said that such a comparison of cost figures will serve to show, theoretically at least, the price that a zinc operator may justifiably expect to receive for his product to compensate him for the increased cost of operation over 1914, assuming that his mill recovery and grade of concentrate are no better and no worse than in 1914, and that his mine "dirt" contains the same number of pounds of zinc per ton as formerly.

The typical costs of a Wisconsin zinc mine may be divided into: Mining: Labor—includes all underground and surface men, except in the mill; powder; supplies—all except for milling. Milling: Labor; supplies. Power.

In a typical cost sheet for 1914, the expenditure under these heads was divided about as follows, in percentages of the total per-ton cost: Mining: Labor, 50.5%; powder, 7.3%; supplies, 8.5%. Milling: Labor, 6.6%; supplies, 4.6%. Power: 22.5%. This classification allows nothing for general expense, including such items as head office, taxes, and insurance charges, the disposition of which may be considered distinct from the working cost.

By regrouping and simplifying the figures given, the following percentages are obtained: Total labor, 57.1%; powder, 7.3%; total supplies, 13.1%; power, 22.5 per cent.

## Payroll Uniform in Larger Mines

The advance in price of labor can be easily calculated from a comparison of the payrolls of 1914 and 1918. The wage scale at the various mines in the district is fairly well standardized, although there are small differences, in some instances on account of special local conditions. But the larger mines maintain wage scales that do not differ much from one another; and this is especially the case where a number of mines are run by a single operating company. Hence a comparison of the wages paid to the different classes of labor at one of the leading mines will serve as a fair index of the rates of pay in the entire district. The following table gives the main division of a typical mine payroll, with rates paid in 1914 and 1918, respectively, and per cent. of increase:

WAGE RATES IN TYPICAL WISCONSIN ZINC MINE, 1914 AND 1918

| Occupation | Wages, 1914 (a) | Wages, 1918 | Increase, Per Cent. |
|---|---|---|---|
| Drill men | $2.25 | $4.00 | 77 |
| Shovelers, contract, per car | .08 | .12 | 50 |
| Shovelers, day pay | 2.00 | 3.50 | 75 |
| Trammers | 2.00 | 3.50 | 75 |
| Track men | 2.25 | 3.40 | 51 |
| Hoist men | 2.25 | 3.40 | 51 |
| Jig men | 3.00 | 4.25 | 42 |
| Mill helpers | 2.00 | 3.50 | 75 |
| Ordinary unskilled hands | 2.00 | 3.40 | 51 |

(a) Nine-hour shift.

No great error is involved in taking the average of these increases to be the increase in the cost of labor, although for mine accuracy these occupations should be prorated in the total payroll, and the average increase thus obtained. A somewhat long calculation based on this showed the average increase of wages to be 57 per cent.

*Mining engineer, Galena, Illinois.

The price of 40% dynamite, the standard explosive in the district, in 1914 was $10.56; in 1918, $21.50. This is an increase of 103.6%. The increase in the price of supplies is difficult to estimate, except approximately, on account of the great variety and number of articles needed at the mine and mill, and the changing demand. Some supplies, for instance, that were in good demand in 1914 have been almost totally eliminated from use in 1918. Inasmuch as the whole amount allowed for supplies is only 13% of the total cost, even a considerable variation will not materially affect the record. The following figures provide a comparison of the costs of materials in 1918 with like costs in 1914, the increase being as follows: Drill steel, 93%; shovels, 111%; mule feed, 41%; mine rail, 100%; oils, 54%; pipe, 125%, and carbide, 46%. An average increase of 60% in the cost of all supplies for mine and mill is probably a conservative estimate. As practically every mine in the field is now operated by electric power, a direct comparison can be made of the increased cost of power. The increase allowed by the commission amounts to 32.5% for the large consumers. By applying these increases against the separate costs already shown, it is possible to obtain the increased cost of operation, thus:

INCREASED COST OF OPERATION AT WISCONSIN ZINC MINE

| | Per Cent., 1914 | Per Cent., 1918 | Ratio of Increase |
|---|---|---|---|
| Labor | 57.1 | 89.6 | 1.57 |
| Powder | 7.3 | 14.8 | 2.03 |
| Supplies | 13.1 | 20.9 | 1.60 |
| Power | 22.5 | 29.8 | 1.325 |
| | | 155.1 | |

The unit costs have therefore increased 55.1% over those of 1914. Applying these figures concretely, it is patent that if the working cost per ton of mine "dirt" in 1913 was $1, a result generally obtained by the large operators who were working on a tonnage of over 10,000 tons a month, the cost in December, 1918, for the same amount of labor, supplies, powder, and power, would be $1.55 per ton. If the mines were then making a 10% recovery of concentrate in the mill, the cost per ton of concentrate would in 1913 have been $10. In 1918, with the same recovery, it would be $15.51.

## The Solution of the Problem

Under these conditions, the operators have four possible sources for relief: First, a reduction in unit costs to pre-war figures, through reduction in wages, and prices; second, a rise in the price received for concentrates that will compensate for the increased costs; third, an increase in the efficiency of mining methods which will offset the increased wages to labor by yielding a larger tonnage per man; fourth, to raise the grade of the ore by mining richer ground, thus increasing the mill recovery at the expense of the mine, and so lowering the cost of making concentrates.

It is questionable, however, if there is any conviction among operators that a radical reduction in wages should be made at the present time. In common with the general sentiment of business throughout the country it is felt that wages are not out of proportion to the cost of living and that any marked reduction would result in considerable hardship and ill feeling. But a readjustment in general wages is likely to occur in the near future, unless ore prices should advance.

Unfortunately for all concerned, the operators cannot expect a higher price for their product. They had their heyday of prosperity, but the high tide of inflated prices for black jack has fallen back to the old pre-war basis, leaving in its wake only a burden of high operating costs. The average price of all grades of zinc ore in 1913 was $42.69 per ton. Present prices (February) are not far from that figure.

## Earlier Efforts Resulted in Improved Efficiency

The third resort of the operators is to increase the efficiency of their mining methods to such a point as to compensate for the increased unit costs. Nothing is impossible, but this a large order, considering that in 1914 much progress had been made by the large companies in the direction of low costs. The question really resolves itself into this: Labor has received a 57% increase in wages. Has it returned the equivalent in increased output? Such a question put to the groundboss would be greeted by a stream of vigorous profanity. Yet in some lines of work the output per man has notably increased, though the credit might be given more to the machine than to the operator. In drilling, especially, there has been a great improvement, due to the practically universal adoption of light one-man hammer drills; and contract prices for breaking rock in stopes are generally lower than in 1914. Output of shovelers per man has been increased about 30%, a result attributable largely to high contract rates paid and closer study of the shoveling problem, with the elimination of weaker and unfit men from this particular work. Shoveling machines have been tried at some mines, but local conditions make them difficult to operate, and little or no saving has been shown over hand work. Better tracks and the substitution of animal and mechanical haulage for hand tramming have resulted in improved efficiency in this work.

It has been hoped that the high price of powder and supplies generally would tend to make the men more careful in their use, and so aid in reducing the cost. No doubt some progress has been made along these lines, where intensive means have been taken to impress on the men the necessity of economy. With regard to economy in the use of powder, however, little comfort can be gained, for the consumption per ton of rock broken in the mine is, if anything, a trifle higher than in 1913. Of course, on account of the shortage of labor during most of 1918, it was often necessary to use powder liberally, as, for instance, in popping boulders and springing holes, when, under normal conditions, more holes might have been drilled at no greater labor cost, and some saving made in explosives.

## The Working of Richer Deposits

There is no doubt that good work has been done in power economy, by closer adjustment and alignment of machinery, and better inspection generally; but the total saving, in comparison with the other factors of the cost sheet, is small. The operators therefore generally have been obliged to resort to mining richer ground; and, by thus increasing mill recovery, they have kept the concentrate cost from rising in the same marked degree as the working cost. Where this has been impossible, on account of the nature of the ore deposit, the usual policy has been to close the mine rather than to exhaust ore reserves on an unprofitable market.

Although present conditions in the district are depressing, it is believed, with reason, that much can be done in the matter of decreasing costs, even on the present wage scale. The attitude of the men generally is good, and it is thought that they will enter heartily into anything that will help keep the mines above water. Some assistance is expected from lower prices for powder and supplies. The operators feel that they have demonstrated in the past their ability to work ground at as low a cost as has been possible in any other zinc district, and, with a turn in the market, it is probable that production will again reach a high figure.

## Recording Flue Temperatures*

When the temperature of hot gases surrounded by colder surfaces is measured with an ordinary thermometer or a protected thermocouple, the temperature indicated by the measuring instrument is always too low. Heat is constantly radiated from the measuring instrument to the colder surfaces, thus keeping the temperature of the instrument lower than that of the hot gases. The error may amount to several hundred degrees Fahrenheit.

The greater the difference is between the temperature of the gases and that of the surrounding surfaces, the greater is the error. Also, the error is larger with instruments having the exposed parts large than with those in which such parts are small. Thus, for an example, a couple having the hot junction inclosed in a protecting tube will invariably read considerably lower than an unprotected couple. The smaller the wires at the hot junction of the couple, the nearer is the temperature indicated by the couple to that of the gases.

The true temperature of the gases would be indicated by a couple having the hot junction made of wire of zero diameter. The true temperature can be obtained approximately by using three or more couples of various sizes and determining from these readings by extrapolation the theoretical indication of a couple of zero diameter.

Ordinary methods of measurement of flue-gas temperatures are on the average about 20° F. too low. Copper-constantan can be used advantageously for this purpose.

## Engineering Education†

BY GEORGE F. SWAIN‡

In the words of that fine old English schoolmaster, Richard Mulcaster, who wrote over 300 years ago, which cannot be improved even today: "The end of education and training is to help nature to her perfection in the complete development of all the various powers." Its aim is to give the student power to meet the problems which life will bring him. Education is strictly utilitarian, using the word in its widest sense. The student should be taught first what is necessary, second what is useful, third what is ornamental. All of these are utilitarian, or useful in the largest sense. The objects to be aimed at are mainly two, discipline of mind, and interest; knowledge is secondary, but discipline should be acquired in subjects which will bring knowledge with it. No effective results will follow unless the student is interested and sees the value, use, and application of what he studies. He cannot appreciate what he studies, or become really and profitably interested in it, in a concrete way, unless he can relate it to his experience. Education cannot turn out a finished product, that is to say, a man fitted to take a responsible position at once. It can only fit him to begin at the bottom of the ladder, and give him the foundation upon which to build. Experience is necessary before he can advance, but, if he has a well-trained mind and the proper attitude, he should gain and assimilate experience rapidly, and progress much faster than otherwise.

We live in a world of other men. To make our way, we need, besides a disciplined mind, many other qualities, such as knowledge of men, tact, personality, perseverance, energy, enthusiasm, power to concentrate, ability to work hard and effectively, and, above all, character. Education should aim to cultivate such qualities as far as practicable.

Education may, on the one hand, be liberal or professional, or it may be vocational. The latter aims to fit young men specificially for a definite occupation, such as a manual trade, or for stenography or bookkeeping. Professional education has essentially the same object, except that a profession is broader in scope and requires a stronger and broader foundation of general principles. Vocational education may be concerned mainly with training the body, or even one muscle, rather than with training the mind. Vocational education will not be considered here, but it may be remarked that it possesses in a high degree one of the most important elements, namely, interest. The pupil becomes at once interested in the work, it is related to his experience, he sees the use and meaning of it all the time. Its results are therefore likely to be satisfactory, even more so than the results of more formal education, and its importance is steadily increasing with the recognition of the fact that one of our main problems is to put the boy in the right place and fit him for a specific job.

Engineering education is in a sense vocational, but as the field of engineering is wide, and rests upon a substantial body of principles of science, it must be broad and must deal rather with those general principles than with any specific job. Yet the line between the two is not sharp, and many graduates of vocational schools make the best of engineers ultimately.

## Magnesite in California

The magnesite industry in California, in common with the other special mineral industries, experienced marked restriction at the close of the war, and, in fact, during the war, on account of the retarding of operations in the building industries. The state for years produced practically all the magnesite of domestic origin in the United States; until 1917 it was practically the only source of the American supply, according to the report of Charles G. Yale, of the Geological Survey. In that year California produced and sold 318,838 short tons, of a total value of $2,116,818, an increase of 37% in value over 1916. The Government requirements after the United States entered the war increased development and production, but the order of the Government curtailing private building operations gave the industry a sharp setback.

*Abstracted from *Bull.* 145, "Measuring the Temperature of Gases in Boiler Settings," by Henry Kreisinger and J. F. Barkley, Bureau of Mines, Department of the Interior.

†Abstracted from the *Bulletin* of the Society for the Promotion of Engineering Education, Dec., 1918, p. 97.

‡Professor of civil engineering, Harvard University.

# Tunnel Driving at Copper Mountain*

BY OSCAR LACHMUND

*The driving of a mine adit under the unfavorable operating conditions that existed during 1918 and the latter part of 1917 is of interest to mining engineers. The adit in question was driven with a daily average progress of 19.3 ft. and at a cost of $35.56 per ft. Before planning the work, the engineer in charge visited mining properties in the West and Southwest to observe the latest methods. This commendable practice is well worthy of more extended recognition and emulation on the part of mining companies.*

DURING the driving of the main haulage level at the Copper Mountain mines of the Canada Copper Corporation, Ltd., near Princeton, B. C., remarkably rapid progress was made, though no claim for a world's record is advanced. Conditions, however, were unfavorable for economical operations. The cost of power was high, for the fuel was of poor grade; besides, during the time the work was in progress, little other power was needed, and most of the power cost was charged against the footage. The transmission line consisted of No. 4 galvanized iron wire, with the result that the line loss was considerable. The voltage transmitted was about 30,000. The plant was operated under a lease, which was due to expire about the same time that the work was supposed to be completed. An extension was refused; therefore speed was most important.

The plans called for a straight adit 2900 ft. in length. At a point 2800 ft. from the portal there are two raises to the next nearest workings, a difference in elevation of about 800 ft. One of these is to be a two-compartment hoistway and the other a zigzag ore pass, or muck run. The position of these raises had been determined by a number of diamond-drill holes, but the material to be penetrated by the adit was not known. It seemed imperative to get the tunnel work completed as rapidly as possible, to allow for delays in the raising program, which were sure to occur. To indicate how closely these operations were timed, it is interesting to note that the date of expiration of the power plant lease was Sept. 1, 1918, and the last round, making the connection between the upper and lower workings, "broke through" in the night of Sept. 3, 1918.

The plans called for a tunnel 9 ft. high by 11 ft. wide; but, owing to the "blocky" nature of some of the rock, a considerable "over-break" occurred. This enlarged the tunnel cross-section to 10.4 ft. by 12 ft. indicated by measurements taken at 200-ft. intervals after the work was finished, and slowed up the work, on account of the extra waste handled, besides increasing the cost per foot of driving. Several zones of geological disturbance were crossed, and the heavy ground encountered necessitated the use of timber supports. More than 350 ft. of heavy timbering was placed at various points along the course of the tunnel; this also retarded the work to the extent of about 6 ft. per day for each set of timber placed. Once the working force was organized and the work well under way, three shifts were put on, each working eight hours.

The drills used were of the Dreadnaught No. 60 type. They were mounted four on a horizontal bar, from which position all but the four bottom holes, or lifters, were drilled, the miners working on the muck pile. Upon completion of the upper part of the round, most of the muck had been removed. That which was left was rapidly thrown back from the face, all hands helping on this work. The horizontal bar dropped to the lower position, from which the lifters were drilled.

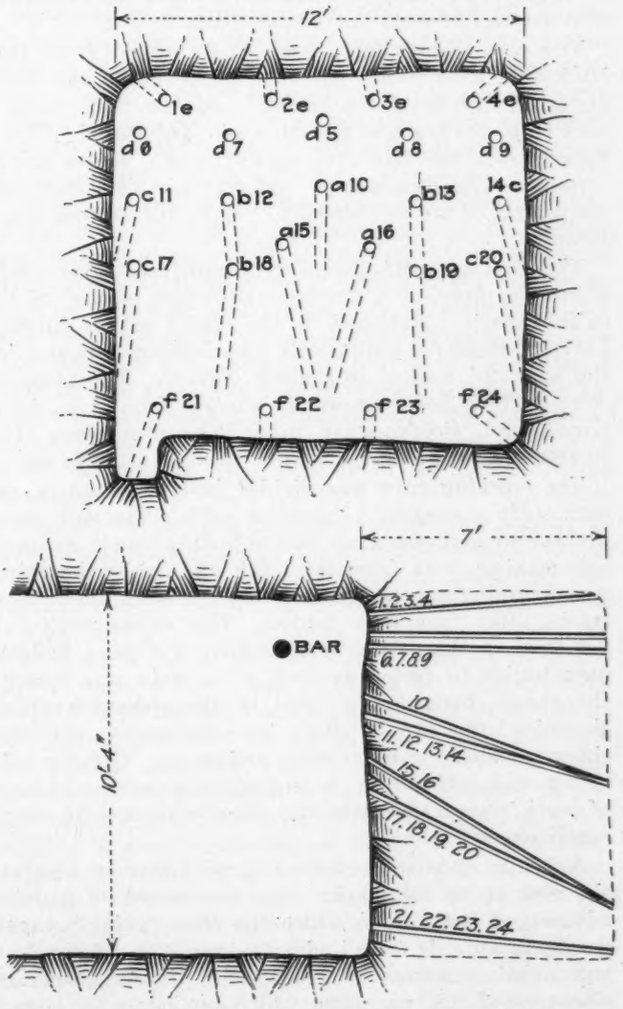



FIG. 1. DRIFT ROUND USED IN MAIN HAULAGE LEVEL, COPPER MOUNTAIN, B. C.

The holes were pointed to pull a 7-ft. round, and averaged about 9 ft. in depth. The center, or "cut holes," were fired first, after which followed the side holes, then the back holes, and finally the lifters. The drift round commonly used in this work is illustrated in Fig. 1, which also indicates the order of firing of the holes in groups. The blasting was done by hand, the fuses being spit. The timing of the shots was regulated by cutting the fuse in different lengths—the shortest for the center holes, the next longest for

*A paper to be presented at the Chicago meeting of the A. I. M. M. E., Sept., 1919.

the side holes, and so on. The lifters were loaded with extra heavy charges of powder, so as to throw the muck back from the face as much as possible. This was sometimes helped by placing charges of explosive outside and beneath the lifters; these were called muckers, and were timed to go off after the rest of the round had been fired. The powder used was a non-freezing kind, varying in strength from 40 to 60% nitroglycerin, the selection of the grade of powder depending on the hardness of the rock at the face.

The rock was handled in small, V-shaped, hand-dump cars of about 1000 lb. capacity. Tramming was done by hand until the distance from heading to dump became too great, when horse haulage was substituted. Later, this was replaced by an electric installation. Steel plates were laid on the bottom for a distance of 30 to 40 ft. from the face, to facilitate shoveling, also to permit shunting empty cars past the loaded trains and thereby eliminating the need for double track.

The cars, being light, were easily pulled from the track and, with bodies tilted, were passed on the steel plates, alongside of the loaded cars, and then pushed back on to the track at the muck pile and loaded. Temporary track was laid close up to the face before firing a round. The T-rails were laid on their side, allowing the flanges of the car wheels to run on the grooves thus formed.

The foul air and gases were removed, after each round was fired, by a Connersville rotary blower, of 10 cu.ft. capacity, stationed at the portal of the tunnel. Later, a similar machine was placed about half-way in the adit and worked in tandem with it. The blowers were set to exhaust toward the surface through a 12-in. wire-wound, wooden-stave pipe. The men were able to return to the heading within 15 min. after firing.

The mucking crew was divided into three gangs, on each shift, averaging 11 men per shift. The work was divided so that one gang was shoveling muck, another was picking down from the muck pile, while the third was bringing up empty cars and forming them into trains after they were loaded. This latter work did not take up the entire time, so that this gang had an opportunity to rest. As soon as a train was loaded. the gangs changed jobs; that is, the pickers went at shoveling, the car handlers took the picks, and the shovelers took the easy work, and so on. Greater efficiency was maintained in this manner, as the change of work rested the men, and they were able to work continuously.

A bonus system was also a large factor in keeping the men up to the mark. This was based on a daily advance of 9 ft., upon which the then "going" wages were guaranteed; for all advance over 9 ft., $6 per foot was added as bonus. For each set of timber placed, an allowance of 3 ft. was made, which applied on the bonus. Current wages at the time were $4.50 for miners, $4 for helpers, and $3.50 for common labor. The bonus distribution brought these amounts up to $5.91 for miners, $5.25 for helpers, and $4.59 for muckers. The foreman and the shift bosses also shared in the bonus, the distribution being made by pro-rating the bonus in the same ratio as the amount of regular wage received by each man. Everybody seemed satisfied, and no difficulties were experienced as far as the labor situation was concerned.

The work was begun on Oct. 9, 1917, and the tunnel was finished Mar. 11, 1918, a total of 154 days. The actual working time was 150 days, four days being lost on account of a break in the power line.

The length of the adit is 2903 ft., and the daily average progress was 19.3 ft. for each working day. The greatest advance in any one month was in December, 1917, when a total of 645 ft. was driven. The amount of rock handled is estimated at 185 tons per day. The material penetrated was granodiorite, for the greater part of the distance. The total cost of driving the tunnel was $103,242.15, which brings the cost per foot of tunnel to $35.56. Certain equipment and supplies were charged against the work that should have been carried in a suspense account, as most of these had a certain salvage value, because it was intended to use them in the future operation of the mines. For reasons already mentioned, such as expensive power, the cost given does not really represent the actual expense of driving. Had speed not been so important a consideration there is no doubt that the work could have been done more cheaply. A few of the cost items are given in the table.

TUNNEL AND ADIT DRIVING COSTS AT COPPER MOUNTAIN MINES

| Total driving cost | Totals | Cost per Foot |
|---|---|---|
| Labor | $25,517.81 | $8.80 |
| Explosives | 16,616.75 | 5.72 |
| Drills, parts and repairs | 2,767.82 | 0.95 |
| Steel, sharpening and replacement | 3,979.78 | 1.37 |
| Miscellaneous supplies | 1,908.27 | 0.66 |
| Power | 8,410.24 | 2,90 |
| Total | $59,200.67 | $20.40 |
| **Rock disposal** | | |
| Labor | $21,843.40 | $7.52 |
| Supplies | 1,685.24 | 0.57 |
| Power | 558.64 | 0.20 |
| Total | $24,087.28 | $8.29 |
| **Timbering** | | |
| Labor | $1,335.52 | $0.46 |
| Timber and supplies | 2,513.18 | 0.86 |
| Total | $3,848.70 | $1.32 |
| **Indirect expense** | | |
| Air and water lines | $5,439.09 | $1.88 |
| Electric lighting | 1,018.81 | 0.35 |
| Ventilation | 3,198.38 | 1.10 |
| Dump, track, and trestles | 503.67 | 0.17 |
| Depreciation on drills | 970.76 | 0.33 |
| Depreciation on cars | 301.82 | 0.11 |
| Surface hoisting and hauling | 3,464.58 | 1.19 |
| Miscellaneous supplies | 1,208.39 | 0.42 |
| Total | $16,105.50 | $5.55 |
| Total cost | $103,242.15 | $35.56 |

| | |
|---|---|
| **Timbering details** | |
| 53 sets timber installed, cost per set | $72.62 |
| 354 ft. of tunnel timbered, cost per foot | 10.83 |
| **Drilling details** | |
| Actual drilling hours | 8022 |
| Actual working days | 149½ |
| Average drilling hours per day | 53.5 |
| Cost of upkeep per drilling hour, in cents | 22.53 |

Before planning any of the work, the engineer in charge visited large mining properties in the West and Southwest, where all the latest methods were observed. From notes taken upon these trips, the layout for future work was developed. The method of driving the main haulage level was derived from the operation of the Pioneer Tunnel, at Glacier, B. C., a few years ago, by the Canadian Pacific Railway.

The credit for perfecting the plans and details of this work belongs to F. S. Norcross, Jr., at that time superintendent of mines of the Canada Copper Corporation, now a captain in the 27th Regiment of Engineers, the mining regiment, recently returned from France. Captain Norcross was unable to complete the job, as he enlisted in December, 1917, but the work was carried cut by his successor and former assistant engineer, P. E. Crane.

# Peculiar Mining Rights

By Chesla C. Sherlock*

Many mining rights are acquired by reason of relationship through contracts, or their many forms, which give rise to situations that may be aptly termed peculiar, because they in turn have their origin in situations which are unusual. Many mining rights are conferred by contract between the operator and the owner of the land in which is located the mineral matter. There is nothing unusual about an ordinary mining contract that will distinguish it from one entered into in other business relations. It has been held many times by the courts that the same rules of law apply to mining contracts as to ordinary contracts; so where there are misrepresentations, deceit, or fraud in the sale of a mining property, or when the rights are acquired by means of a contract, the same rules of law apply as if the contract had other subject matter.

One authority has said: "There is no presumption of law that one who, when about to purchase a mine, makes an investigation himself, and consults others as to the condition of the mine or its value, does not rely upon representations made by the seller. Nor is it necessary that a mine be shown to be worthless to entitle one defrauded into purchasing it to hold the seller liable for the loss inflicted upon him."

It is a fundamental proposition of the law of contracts that the law of the jurisdiction applies in construing contracts; and the same rule ordinarily applicable to contracts will apply unless the statute has provided differently in the case of mining contracts. In regard to concealment and misrepresentation of the value of mining property, it is generally held that the seller will be liable. Surface indications, on the other hand, which are open to all observers and which must have been known to the vendee, cannot be the subject of concealment or misrepresentation. This is based upon the theory that what is open and readily discernible to all is presumed to be seen and known by all, particularly by a purchaser; and it is therefore impossible for the seller to be guilty of concealment of something which cannot be concealed.

A substantial breach of the contract will naturally permit the other party to escape performing his share of it, but an unsubstantial breach of a contract will not justify the entire abandonment of it. In the case of options, some peculiar rights arise which are often misunderstood by the parties. In the first place, an option to mining property creates no right or interest in the property until it, the option, has been exercised. It comes into being, or its distinguishing features come into being, only after it has been exercised.

An option is, of course, a form of a contract, but it possesses only potential rights in one sense. It may be of great value, but it has no value whatever until it is used. The mere taking of an option creates no estate in the property itself until it has been exercised, so a failure to exercise it in the manner agreed affects the holder in precisely the same way as if there had never been an option.

Time may be, and very frequently is, of the essence of the contract for sale, and it may arise either by express agreement of the parties, their relation, or from the nature of the property. When an option is made to a particular person, an assignment of it to another, not considered as a party in interest at the time the agreement was entered into, will confer no rights upon such assignee. This is particularly true in instances where the option is given to "John Jones and none other," or "only to John Jones," but it has also been held to apply to cases where the particular person is specificially designated, so as to have the inference that it was to be exercised only by him.

These rights often arise under the form of a lease. The subject of whether a lease was merely a lease of lands or a sale of the property has already been discussed in these columns. There are two views of the matter, the one holding that it is merely a lease of lands, whereas the other maintains that a lease of mining property is a sale of the land. The solution of the question is to be determined in each case by two things: (1) the facts surrounding each case and (2) the law of the jurisdiction.

Assuming that a lease of mining property is merely a lease, the owner of the surface is held to be the owner of the whole land. The lessee has the right to use the land only for a specific purpose—getting out the mineral. Under the other rule it is held that a lease creates title in the mineral, the time specified being merely an indication of the time in which the lessee must get his property out of the land.

There is more or less doubt over this question, and it can be settled in each instance only in the manner suggested, although it is a principle of the courts to look upon the intention of the parties as the controlling factor. It is true that a lease may be given; but, if a sale was intended, then it is as much a sale as if a deed had been executed instead of the lease. Likewise a deed of sale may be given when only a lease was intended. As one court has pointed out, the question as to what kind of paper was given does not amount to much, but, rather, the intention of the parties is the important factor.

There is no implied warranty in a mining lease as to the fitness of the property for the purpose intended. A lessee has a right, under a lease, to work all open mines, even those of which no mention is made, but he has no right to open new mines. Likewise, if there are open mines, the lease will not extend to unopened mines; and if there are no open mines, a lease covering all mines will entitle the lessee to open new mines.

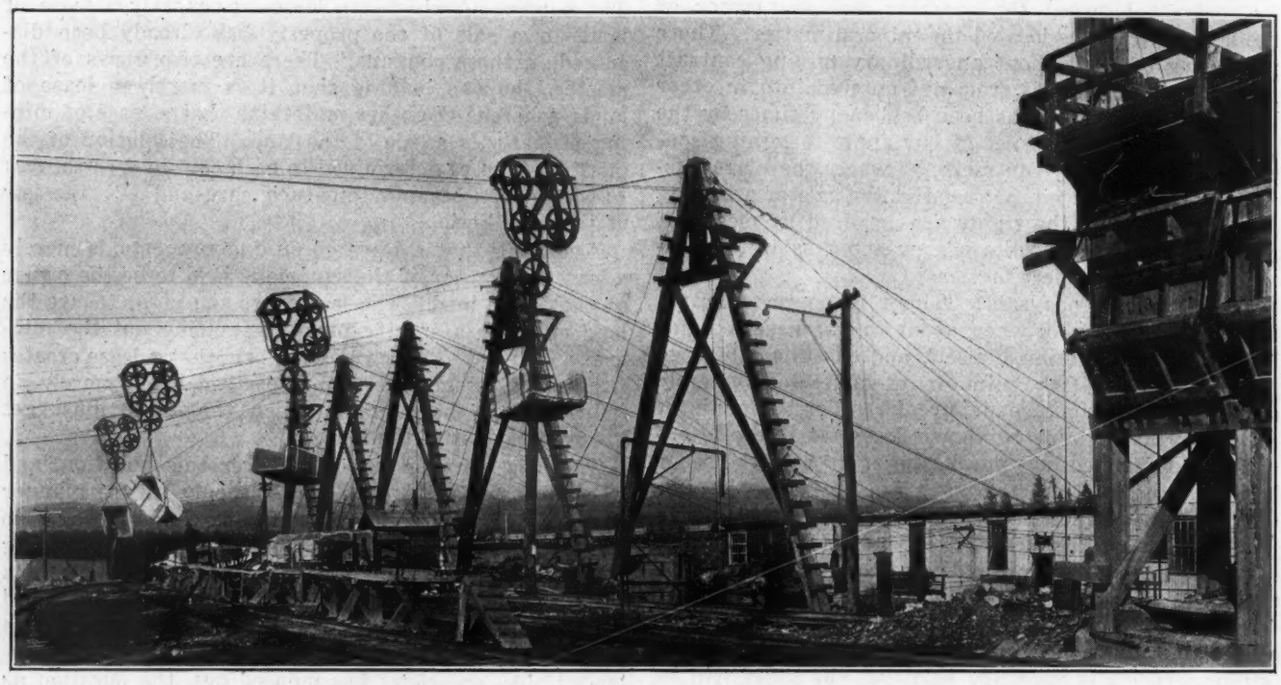
Mining rights are often acquired through the form of a license. It is hard for many persons to understand the distinction between a lease and a license. In the first place, a lease is a distinct conveyance of an actual interest or estate in lands. A license is a mere incorporeal right to be exercised in the lands of another. And it is necessary to go to the law of the jurisdiction to determine whether the writing is a lease or a license.

In Indiana it was held that a writing acknowledging receipt of certain money in payment for a certain sand bar for one year, with "the exclusive right to all gravel and sand for the year above named and excluding all other parties from said premises," was a lease and not a mere license. A license may be the subject of revocation, unless the law of jurisdiction by specific provision states otherwise, and if it has not been executed, and no expense incurred upon it, so that revocation would cause injury.

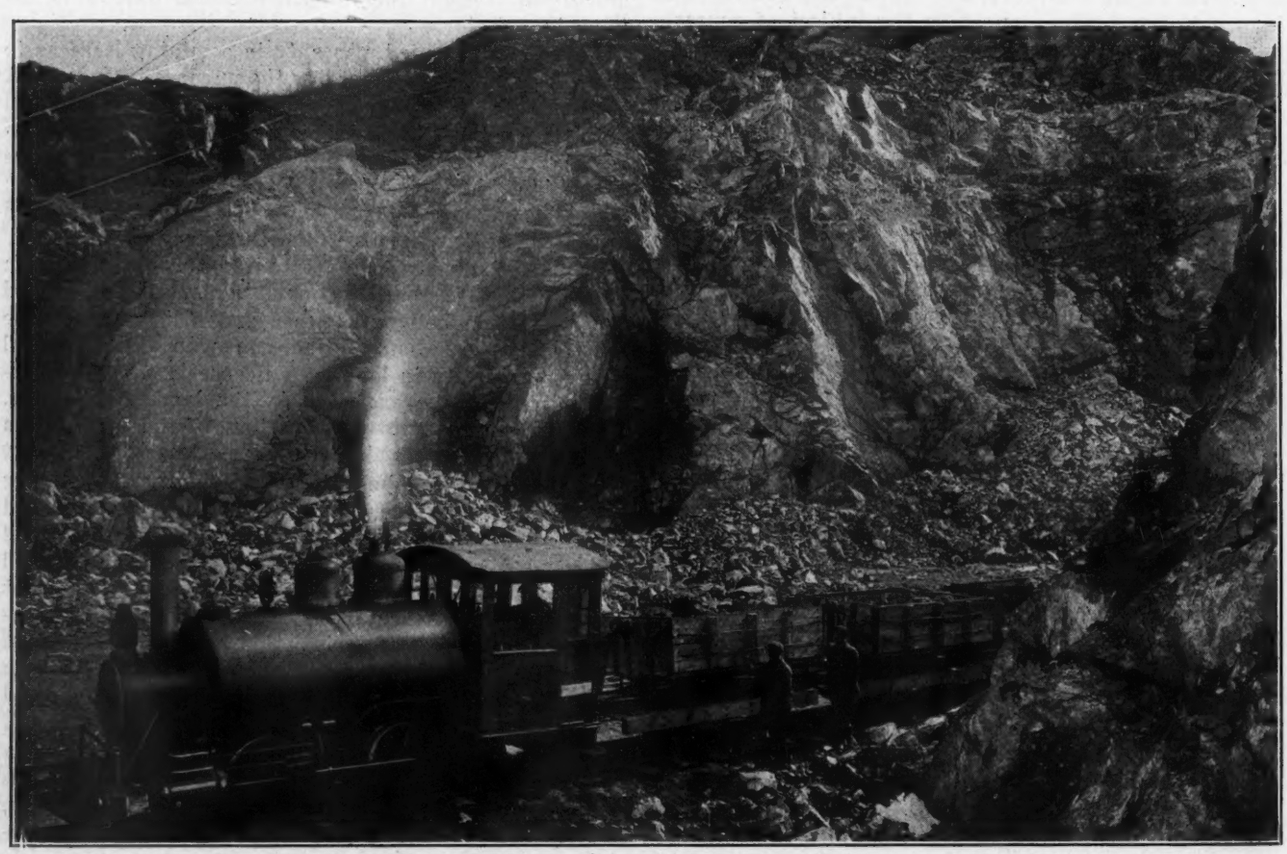
A license is non-assignable in quality, but where a person holds a license to dig ore on the property of another, it will exempt him from an action for trespass, and conveys property in actual ore dug under such provisions.

*Box 84, University Place Station, Des Moines, Iowa.

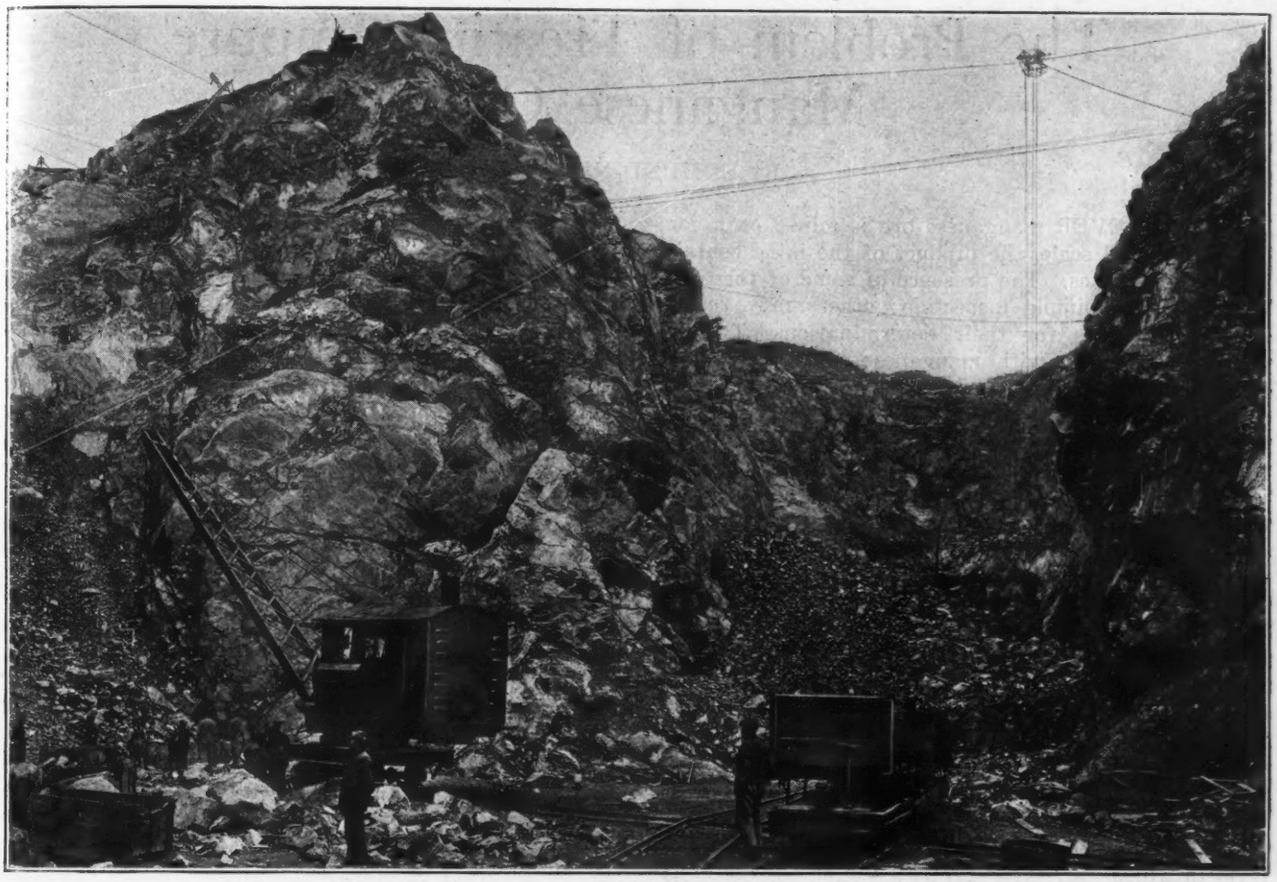
# Mining Asbestos in Quebec



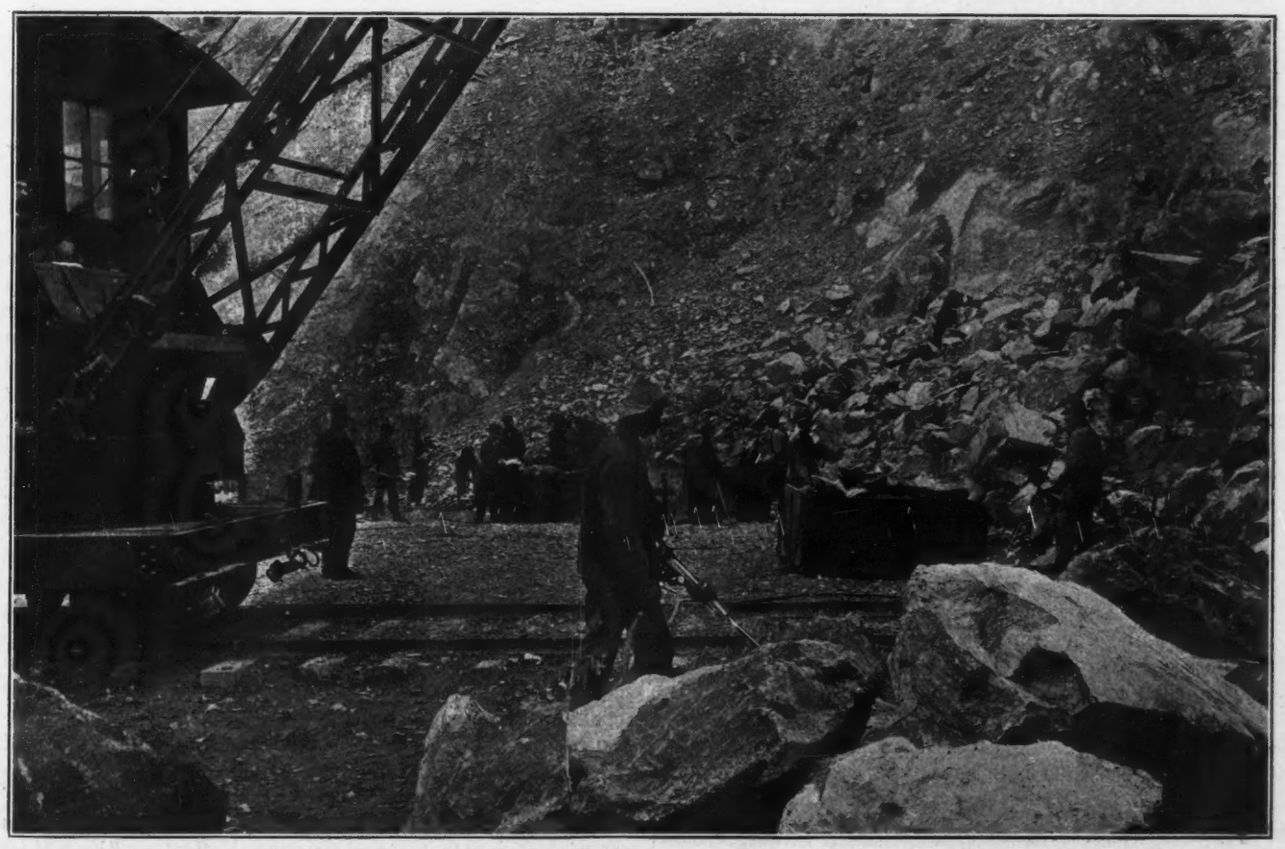
CABLEWAYS IN THETFORD ASBESTOS DISTRICT, SHOWING METHOD OF TRANSPORTING ROCK



OPEN-CUT ASBESTOS MINE AT BLACK LAKE, QUEBEC



PART OF ASBESTOS OPEN-CUT MINE AT THETFORD MINES, QUEBEC



OPEN CUT AT THETFORD MINES, SHOWING CRANE USED IN HANDLING ASBESTOS ROCK

# The Problem of Treating Impure Manganese Ores*

By EDMUND NEWTON

WHEREVER manganese ore is mined on a commercial scale, the product of the mine contains impurities. The presence of some of these will be obvious by simple inspection; others may require chemical analysis for their determination. The impurities associated with manganese minerals may be classified as (1) those derived from associated rocks, or rocks partly replaced by manganese-bearing solutions, (2) those associated with the manganese in solution, and deposited simultaneously, and (3) those chemically combined with manganese in the mineral. From the point of view of the metallurgist, all are impurities, and must be removed either by hand or by metallurgical treatment, and they may be classified according to certain general physical and chemical principles as follows:

1. Metallic—Iron, lead, zinc, silver, and, in some cases, nickel, copper, and tungsten.
2. Gangue—"Basic" lime, magnesia, baryta, "acid" silica, and alumina.
3. Volatile—Water (atmospheric moisture and molecular water), carbon dioxide, and organic matter.
4. Miscellaneous—Phosphorus and sulphur.

The chemical behavior of the impurities mentioned affects metallurgical operations, whereas the physical form in which they occur controls the possibility of removal previous to smelting, and the choice of methods by which such removal might be possible. The proportion of manganese to useless or harmful constituents of the ore determines its value and desirability.

The presence of appreciable quantities of any impurity means that more ore must be mined and smelted to produce a given weight of manganese alloy. Some impurities, however, are more detrimental to alloy manufacture than others. Metallic impurities, of which iron is the most common, will usually be reduced and retained by the alloy. The quantity present naturally affects the character of the alloy produced, which, in turn, controls its desirability for use in steel manufacture. Other metallic impurities occur usually in such small amounts that they are not detrimental to the resulting alloy. Zinc is an exception. This metal is largely volatilized in the smelting operation, and, if present in appreciable quantities, the fume will condense as oxide in the hot blast stoves, which may interfere with furnace operation. Unless the furnace top gases are washed, the stoves must frequently be cleaned, with consequent loss of time. The zinc oxide recovered from the stoves yields a substantial sum when the price of zinc is high.

Silver is neither detrimental to manganese alloys from the standpoint of the steel manufacturer, nor is it advantageous. The silver content of a manganese alloy has no value; consequently, no credit is allowed the miner for silver contained in an ore to be used for manganese-alloy manufacture. In some cases, the amount of silver contained in a manganiferous silver ore is such that it has greater value for the lead smelter. The manganese then acts as a flux, and the silver may be recovered by purification of the lead.

*Abstracted from Pamphlet 9, War-Minerals Investigation Series, U. S. Bureau of Mines.

The gangue impurities classed above as basic and acid may also be called "slag-forming impurities." In smelting, these impurities must be fluxed to form slag. Slag is usually considered a waste product of a smelting operation, but it has important metallurgical functions, and just sufficient slag must be present to properly and economically perform those functions. An excess of slag must be avoided. In manganese-alloy manufacture, the slag contains more or less manganese, which does not enter the alloy. The quantity of manganese thereby lost is dependent upon the basicity of the slag, the temperature, and the slag volume. The first two factors control the quantity of manganese in a given weight of slag, and it is obvious that a greater quantity of slag will result in a greater loss of manganese. A large slag volume will rapidly decrease the daily alloy output of a blast furnace of given size. The overhead charges must be distributed over a smaller daily tonnage of alloy, and the profit from the sales of alloy for a given unit of time will decrease. It follows that more than the quantity of slag required to provide for the metallurgical functions is undesirable.

Silica is usually the predominating slag-forming constituent in domestic manganese ore. A certain quantity of silica is reduced to the metallic state in the smelting operation, and is recovered in the alloy as silicon, but the larger part must be fluxed with lime, magnesia, or other bases to form slag. Manganese-alloy slags should be basic; hence a larger quantity of slag will be produced from an ore with acid gangue than is the case in normal iron blast-furnace practice. Alumina is a slag-forming constituent, and although usually classed with silica, it acts somewhat differently in blast-furnace operations. Brazilian ores are notably high in alumina, but most domestic ores contain relatively small quantities.

Lime, magnesia, and baryta in an ore are also slag-forming constituents, but they combine with the silica and alumina present and thereby reduce the quantities of those bases necessary in the form of limestone or dolomite for the furnace charge. Baryta is not common as a gangue mineral. It is not as strong a base as either lime or magnesia. Though these constituents offset the metallurgical effects of silica or alumina, as regards evaluating an ore, they represent weight, and if the ore must be transported a considerable distance to the point where it is smelted, it is doubtful whether their value as bases would equal the additional freight charge. Limestone can generally be obtained at low cost close to the smeltery.

Volatile impurities are removed from the top of a blast furnace largely by the surplus heat. It is desirable, however, to reduce the loss of manganese from this cause, to keep the top of a manganese-alloy blast furnace cool. Volatile compounds are not particularly detrimental to smelting. When carbonate ores are being treated the case is somewhat different. Some metallurgists claim that in treating rhodochrosite ores the ratio of carbon monoxide to dioxide in the furnace gases is disturbed, which has a detrimental effect on the reduc-

tion of the oxides in the upper part of the furnace. It has also been suggested that the carbon dioxide driven off combines with carbon of the coke, forming carbon monoxide in the upper part of the furnace, and thus increases the coke consumption. Definite data are not available on these points.

From the practical standpoint, all the phosphorus in the ore mixture, together with that contained in the coke and limestone, is recovered in the resulting alloy. The permissible quantity of phosphorus in an alloy—the amount that does not produce detrimental effects when added to steel—has not been definitely determined. The higher the manganese content of an alloy, the larger the quantity of phosphorus that may safely be contained. Ordinarily, steel makers desire as large a margin of safety as possible, and therefore have specified that phosphorus shall not be above a certain percentage in an ore. Sulphur usually exists in relatively small quantities in oxidized manganese ores; but in the primary rhodocrosite ores of Butte and other parts of the West considerable quantities of sulphides of iron and zinc may be present. Sulphur is not a serious factor, as the conditions of blast-furnace operation, when making manganese alloys, are such that sulphur combines with manganese or lime, and is readily retained by the slag. Only traces enter the alloy.

Knowing the effect of impurities in manganese ores on blast-furnace practice, the methods of eliminating them may now be considered. In the first place, it is essential that the physical and chemical characteristics of the ore be determined. These factors are conditioned largely by the type of deposit from which the ore is mined. The following are recognized as types of ore, entirely disregarding genesis:

1. Rhodochrosite and rhodonite; carbonate and silicate ores, deposited in fissure veins or replacing original rocks.
2. Nodular ores, accretions of manganese oxide in soft plastic clays.
3. Manganese oxides deposited in small fissures or fracture planes, as breccia fillings, or as more or less impure beds.
4. Manganese oxides occurring as infiltrations, deposited in minute pore spaces, as partial replacements, or otherwise intimately mixed with the rock or gangue.

In the first class of deposits, the principal gangue impurity is silica, although sulphides of silver, lead, zinc, and iron are often found in appreciable quantities. The silica occurs both as quartz and chemically combined in rhodonite ores. In the carbonate ore, the carbon dioxide may be removed by calcination, thus effecting a concentration of manganese, reducing the bulk, and lowering the freight rate per unit of manganese contained in the original ore, but rhodochrosite decrepitates strongly when heated to a temperature where the oxide is formed, tending to produce an excessive amount of fines which is undesirable in practice. The breaking up of the particles by calcination will isolate some of the free silica, which on account of the larger sized particles might be screened out. The sulphide minerals may occur in such quantity that it is desirable to remove them by gravity methods of separation.

In the second class of deposits, the nodules are of variable size and usually high in manganese. They do not appear to be contaminated internally with the enclosing material. The clays are soft, whereas the nodules are generally hard. This type is common in the Appalachian region of the United States. The clay may be separated from the manganese nodules by log washers, followed where necessary, and where the size of the deposits warrants the installation, by picking belts, crushers, screens, and jigs.

In deposits of the third class, the manganese minerals, although closely associated with the inclosing rock, are not generally contaminated by it, and may be relatively pure. The method of treatment will vary with the size of the manganese particles and the hardness of the rock, but will not differ essentially from the treatment of the second class. If there is little or no clay, the log washer will be omitted and crushing, screening, jigging, and possibly tabling will make up the concentrating process.

It should be noted that if the mineral is largely pyrolusite, and therefore friable and soft, crushing may produce an excessive quantity of fines, composed of manganese minerals which are difficult to recover by gravity or water methods of separation. If, however, the manganese mineral is of hard, dense, massive variety, and the inclosing rock more friable, the problem is simpler. When the specific gravities of the minerals and the gangue approximate each other, wet concentration is difficult unless there be a marked difference in the size of particles.

As regards concentration, it is obvious that the association of gangue materials with the desired mineral in ores of the fourth class is so intimate that the finest crushing imaginable would not permit separation by mechanical means. To this type, the siliceous manganese ores of the Western States may be assigned. Ore-dressing experimentation has conclusively shown that where the silica is chemically combined with the manganese, or where colloidal silica envelops the manganiferous particles, any wet process or gravity concentration will not give the desired results.

## The Victory Loan

Americans want to make money individually.

Americans want their nation to be prosperous.

Americans want their Government to be recognized as a world-leader—liberal, enlightened, powerful.

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These are worthy and commendable desires. Americans can accomplish all this by subscribing to the Fifth Liberty Loan—the Victory Loan—as enthusiastically and liberally as they subscribed to the four preceding loans. Through saving and thrift they can buy the new short-term notes. In buying them, they assure themselves a good interest rate on the investment and obtain securities absolutely safe and otherwise desirable. They will contribute to an era of national prosperity. They will enable their country to maintain the proud position of eminence it has gained through its position in the war. They will have the consciousness that their dollars have helped to reap the fruits of victory, as their dollars lent to the Government before helped to win that victory.

About thirty million Americans have bought Liberty bonds in the four previous issues. There is not a single reason why every one of them should not become a subscriber to the Fifth Liberty Loan.

# Principles of Taxation*

*Professor Seligman briefly outlines the history of the principles of taxation, drawing attention to the fact that they have changed from century to century with the alteration in economic conditions. Perfection can never be reached, because methods of taxation cannot overtake those changing economic conditions just ahead of them. The most modern conception of the subject regards wealth in terms of flow rather than in terms of a fund; and, if tax is collected on income only, perfection of method is approximated.*

IN A SHORT address it is a little embarrassing to know how to pick and choose from such a subject as the principles of taxation, so perhaps if I confine myself to those broad principles which may be of interest to you as mining engineers it will be best, and may help to throw light on some of your practical problems.

There are principles of administration, of assessment, of convenience of payment; there are principles connected with economic results and social consequences of taxation, as the securing of economic efficiency, which is just as important in fiscal matters as in other business. I believe, however, that what interests you above all are those principles connected with equality of taxation—those ethical principles of taxation which in a democracy are of the greatest importance, and which make all the difference between justice and injustice.

The world has been struggling with the equality of taxation for years. We are not the first to whom the problem has been presented. The primary question is with what criterion are you going to measure equality and uniformity of taxation? It is easy to say, as our laws have said almost from the very beginning, that individuals should pay in accordance with their ability or faculty, and we all give lip homage to that conception. But how are you going to measure a man's ability or faculty? The ideal democratic conception is that equality of taxation consists in every man paying what he can afford to pay, and that is the criterion of what he ought to pay.

If we take a broad view of history, we will find that many different answers have been given to the question of how to measure the ability of people to pay. In the beginning, in primitive society, we find the theory that everybody should pay as a poll tax so much per head. It existed in all democratic communities at the outset, and today it survives in a few centers. The United States is about the only country outside Switzerland where you still find the poll tax. This criterion of the peoples' ability to pay is antiquated and absurd, because with the development and differentiation of property there follows inequality between individuals.

The next stage was that of the Middle Ages, when the theory was *"le fort portant le faible,"* or that the rich man should bear the burden of the poor man. In practice it worked out the other way—the poor man paid most of the taxes. When this failed, an attempt was made to reach the rich man by taxing him upon what he spent. Then for a long time in England, France, and Germany the test of ability to pay was deemed to be expenditure.

This practice was abandoned as democracy developed, for the simple reason that, whereas the poor man must spend all that he earns, the rich man is under no such compulsion. The opinion grew and was strongly held (as evident from the discussion on our income tax in Washington a few years ago) that so far as possible we must do away with tax on expenditures, except perhaps during war, when the object is largely to reduce consumption to the lowest possible limits. With the disappearance of expenditure as a criterion, the world came to accept the idea which is still found universally in our state laws—that property is the test of ability to pay, whether held by persons or corporations. Property is a legal, not an economic, term. Wealth, of course, is what we are after. When we say that people should pay in accordance with their ability to pay, we mean in accordance with their wealth. Wealth may be measured in terms either of a fund or a flow. It may be measured either in terms of capital or in terms of income received during the year. Capital is capitalized income.

Under the feudal system of England land could not be bought or sold; hence a man's wealth was sometimes measured in terms of rent received from his estate. When our country was constituted, however, the feudal system had disappeared. Land was freely bought and sold. Therefore it became possible to measure wealth in terms of property, which is nothing but capitalized income. From the beginning, therefore, we have developed in this country the system of property taxation.

For a long time property was a good test of ability to pay—an admirable test under the only conditions of a simple economic life. It has certain advantages even today, as in local real estate, where one can easily measure the value of a house or lot. As a result of modern economic life, with its complexities, people began to find that there were shortcomings to this mode of measuring wealth. An ordinary business man is averse to measuring his business in terms of his property. This is so because of the interrelation of economic conditions. Speculations and hazards have no exact equivalent of capital. If you were to compare the owner of a $10,000 farm with the owner of $10,000 worth of a speculative stock you would not find the economic faculty and ability of the two precisely the same. There is often a disparity between income and the capitalization of income due to the changes in our modern economic life.

Again, take the business man, whose capital consists of his stock in trade, and his prospects of business. If you take property as the test, no consideration is given to the frequency of turnover or other factors affecting his profits. Of two men having precisely the same stock in trade, one may make ten times as much in a year as the other. Hence, some doubt has been cast upon the alleged equivalency between actual property and the ability of the individual to contribute to the support of the state.

In modern society we find other changes. In former times, as in early New England, every man worked, and few had more than an insignificant amount of property. Now there are two divergences from this idyllic period. On the one hand, the careful, thrifty worker

*Abstract from an address by Prof. E. R. A. Seligman before the New York section of the M. M. S. A., Feb. 27, 1919.

may accumulate some property, whereas the spendthrift of a much larger income may spend all and accumulate nothing. The taxing of property makes its accumulation by thrift a penalty. In the second place there are many individuals in modern times who secure their incomes from professional services rather than from property. A gets $10,000 from his property or business, B gets $10,000 from his professional services. If property is taxed, A pays, B does not pay. It lets you professional men off too easily. When we think of our railroad presidents, with incomes of $100,000, of our Carusos and Charlie Chaplins, and recollect that a tax on property does not reach them, more and more doubts are cast upon the property criterions of ability to pay. Leaders in all European countries have seen this and have abandoned property as the test of ability.

To what did they turn? They turned to the product. Whether it was a mine or anything else, they took the yield of the land, or the yield of the business, or the yield of the money, as the test of ability. This was done as far back as Biblical times, when gross receipts were the measure. A tax on gross receipt is very unjust and primitive, because it does not consider expenses, and puts no premium on good management. Later, the plan of considering net receipts or the net yield of the taxable object as a criterion was tried for a long time.

The trouble with net receipts or net yield as applied to a business lies in the fact that no attention is given to the personal characteristics of the owner of the property or business. A uses his own capital and gets net results of $10,000. B borrows his capital, and out of his net receipts pays a large amount of interest. The net receipts tax or net yield tax does not consider the personal position of the owner of the property, and it too has been abandoned.

Thus first in England, then in all other democracies, and finally in this country, we came to the taxation of income as the best test of ability or faculty. When this country needed a great additional revenue at the time of the war with England a century ago, we imposed a tax on property. When we needed a great revenue in the present war, we imposed a tax on income. Our whole point of view had changed in a hundred years. We see that modern economic life depends primarily upon income rather than upon property.

In this country we are in a stage of transition, which has been accomplished everywhere else in the world. France achieved the result a few years ago, but we have only just begun. Some states are trying to tax the yield or produce of the property. The taxation on mines in some states is upon gross receipts; other states are taxing what they call the net receipts, but something that is really not net receipts at all. Finally, some of the most advanced states have adopted what is now being considered in New York—the tax on income.

I have tried to point out that an equitable system of taxation must be one that is in harmony with the economic features of the day, and that an attempt to perpetuate an antiquated system, a system which was once admirable but which no longer responds to the economic environment, can by no possibility form an adequate, satisfactory test of ability to pay. Many of us are trying to cope with the practical difficulties connected with the valuation of property for taxation, and they are difficult because it is a transition problem. We can clearly see, from this sketch of the historical development, in what direction we are going and where the remedy lies.

If you measure wealth in terms of flow, rather than in terms of a fund, you are getting much closer to the modern conception of justice in taxation. I venture to predict that in mines, as in other forms of enterprise, the problems of income taxation, difficult though they be, will gradually turn out to be far less difficult and far less involved than the almost insuperable obstacles that confront us when we attempt to measure the wealth in mines in terms of a fund.

Even though you have worked out the general principles or criterion of ability to pay, the practical solution depends upon your administrative system. Here again we are living in the early stages of a transition which has long since been passed in the more developed countries of the Old World. In the early days taxes were farmed out and were collected by the tax farmers, such as the publicans of the Bible. Then came the period of local assessors, which we still have in this country. Finally, with the development of the principles of equality and uniformity of taxation, we get centralized assessors.

The great struggle confronting mineral and other enterprises today is the attempt to secure equality by removing the administration of the tax from the hands of poorly equipped local officials to the more highly efficient administrators of the central government. Wherever you find a successful state income tax today, you will find it only where you have a centralized state administration.

The two points which I should like to leave with you are that (1) in the solution of the mining-tax problem it must run on "all fours" with the solution of all taxation problems, and (2) that it must certainly be in harmony with two principles. It must be in conformity with the facts of the changed economic environment of modern times, and it must respond to the newer ideas of administrative efficiency.

If you adopt a system which is based on these two principles, you will get about as close as you can to a just one. You will, however, never reach it, because, as the old adage says, "He who expects an honest tax to see, expects what ne'er was and ne'er will be."

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# Geology of Montreal River District Of Northern Ontario

TORONTO CORRESPONDENCE

The Summary Report of the Canadian Geological Survey (Part E) for 1917 includes a paper by H. C. Cooke on the Montreal River district of northern Ontario, embodying the results of an exploration undertaken on account of the interest aroused by the Matachewan gold discoveries, rendering it probable that prospecting would be carried into the adjoining districts. Micrometer and prismatic compass surveys of the water routes were made through the townships of Midlothian, Montrose, Hincks, Argyle, Bannockburn, Doon, Yarrow, and Powell. Hitherto little information as to the territory covered has been available, owing to the fact that there are no large streams or lakes to render travel or survey easy.

The district is the source of many streams whose drainage basins interpenetrate one another complexly, and is characterized by numerous small creeks and

lakes. The portages connecting these were in many places poorly marked Indian trails, difficult to find and to follow. The district includes the northern boundaries of the large area of the Cobalt series of sediments, which extend northward for many miles. Within the limits of the Cobalt series the country is rugged, with a relief in places of as much as 600 ft. Beyond the limits of the Cobalt series to the north and west, where older rocks prevail, the general elevation is much lower, with an average relief of not more than 100 ft., except in a few places where a knob or ridge of unusually resistant rock protrudes. Much of the flatter country has been made the depository of accumulations of glacial moraine.

At the base of the rock formations of the district lies the complex of igneous rocks commonly known as Keewatin, though the name may not be altogether applicable, as it appears probable that some of the units at present mapped with the igneous complex may prove to be much younger. The igneous complex consists of basalts, andesites, rhyolites, and other volcanic flows. Some or all of these are cut by later dikes or diabase, strongly resembling the Cobalt gabbros, but which are nevertheless older than the Cobalt series. The relations of these dikes, some of which are highly porphyritic, with phenocrysts of feldspar an inch or more in diameter, are well shown on the Davidson claims in Powell Township. The volcanic flows are also cut in the western part of the district by silt-like bodies of peridotite, now altered more or less completely to serpentine, in which deposits of asbestos have been found. In Midlothian, Doon, Bannockburn, and Powell townships, the basement complex is overlaid by what has been termed the Temiskaming series, which the writer prefers to call the Kiask series, as the term Temiskaming implies an unproved correlation with the Temiskaming of Cobalt and vicinity. The Kiask series, so far as observed, is wholly sedimentary in origin, consisting of coarse conglomerates, grits, and slates. Granite and syenite in large and small masses intrude the basement complex throughout the district, but no locality was found where granitic rocks came in contact with the Kiask series. The Cobalt series, cut by dikes of quartz and olivine diabase, overlies all the other rocks described.

The gold discoveries in Powell Township on the Davidson and Otisse claims are of two types, those in porphyry and those in schist. On the Davidson claim the gold impregnates an irregular body of porphyritic syenite intrusive into the basement complex. The periphery is cut by a network of closely spaced veinlets of quartz. The gold is usually found in or near these veinlets, though Mr. Davidson states that it is occasionally found in the porphyry several inches from a veinlet. It appears probable that the gold was introduced by the solutions forming the veins.

On the Otisse claims gold is found both in the porphyry and in the schist, its occurrence in porphyry being similar to that on the Davidson claims. The principal schist occurrences appeared at the time of examination to be in beds of calcareous tuff, which has been heavily impregnated with small grains of pyrite. These have since been reported, by engineers examining the property, to carry high metallic content.

The area to the west, especially in Argyle, Hincks, and Montrose townships, may well yield similar discoveries if carefully prospected, especially in the neighborhood of small granite masses. One such small mass crosses the Powell-Bannockburn line between the 3 and 4½ mile posts. Another granite ridge runs north and south through the center of Hincks Township, and a third much larger mass crosses the southern parts of Cleaver and McNeill townships. It is probable that dikes of granite porphyry will be found in the neighborhood of these masses and that some of the dikes will have gold associated with them. With the exception of these granite masses, the townships mentioned are underlain largely by Keewatin rocks, in which may be expected tuffaceous beds of the type which occur enriched in Powell Township. The probability of the occurrence of gold in this area is indicated by the statement of J. Davidson that he had panned gold in several places during prospecting trips.

Asbestos appears to be a valuable potential resource of the district which would repay more attention than it has hitherto received from prospectors. George Rahn has held several claims of asbestos in the western part of Bannockburn for some years. The asbestos, which occurs in serpentinized peridotites, is of fair quality, if fiber of sufficient length can be obtained. The attention of prospectors is also called to the possibility of finding chromite in the serpentine.

## American Tin-Slag Analysis

The following report gives the results of a number of exhaustive tests made on a sample of American tin slag by M. G. F. Söhnlein, of Machacamarca, Bolivia. The results are so noteworthy and the descriptions of the various tests so complete that the information is of general interest:

CONTENTS OF AMERICAN TIN SLAG

| | Per Cent. |
|---|---|
| Total tin content | 14.59 |
| Content of metallic tin | 1.92 |
| Content of tin in form of unreduced barrilla | 0.58 |
| Content of tin in other form, presumably silicate | 11.93 |
| Content of metallic iron | 3.71 |

Ten grams of the sample was ground to pass a 200-mesh screen, using an agate mortar and pestle so as to avoid contamination with iron from grinding apparatus. Small flakes of metal that remained on the screen proved all to be magnetic, and, if metallic tin is present in the slag, it must be extremely finely divided. Two grams of the finely ground material, into which the metal flakes had again been carefully mixed, were used to run a duplicate assay for total tin on 1-gm. samples, which returned, respectively, 14.61 and 14.57%, from which the average was taken as the correct figure.

The amount of tin in the form of unreduced barrilla is usually determined by digesting the sample with aqua regia, and assaying the residue for tin. This method is open to objection because, if metallic iron and tin be present, the nascent hydrogen evolved by the reaction between the acid and the metals may reduce some $SnO_2$ to Sn, which will be dissolved in acid, thereby diminishing the amount of $SnO_2$ left in the residue. It is therefore better to remove all metal before digestion with aqua regia. Metallic iron can be removed magnetically, and metallic tin by amalgamation.

A portion of the finely ground sample was treated by magnetic separation, yielding 7.20 gm. of non-magnetic product and 0.45 gm. of magnetic product. The latter was gently heated with diluted hydrochloric acid (1 to 10) so as to dissolve the metallic iron only and leaving

the remainder, consisting of slag, which is a mechanical contamination of the magnetic product undissolved. There was 63.1% of metallic iron in the magnetic product, or, computed on the whole sample, 3.71%. Only a trace of tin was found in the solution that had extracted the metallic iron. The residue of the magnetic product was digested with aqua regia, evaporated to dryness, taken up in strong HCl, evaporated again, and finally dissolved in strong HCl, diluted and filtered. The amount of tin in the residue was determined in the usual way by fusing with $Na_2O_2$ and titration with iodine, and proved to be equal to 3.1 mg. of Sn. The solution contained 44.6 mg. of Sn. Recalculated on the whole sample, these figures give a content of 0.04% Sn in the form of unreduced barrilla, and 0.58% in Sn as silicate.

The non-magnetic product was amalgamated for one hour by rubbing it down with 2 gm. of quicksilver in a porcelain mortar. The amalgam was separated by careful and repeated panning, and digested with strong $HNO_3$ to dissolve the Hg and leave the Sn as metastannic acid. This was filtered off, and the amount of Sn contained in it determined by fusing with $Na_2O_2$ and titrating with iodine. The amount of Sn extracted by amalgamation amounted to 147.1 mg., which is equal to 1.92% on the whole sample.

The tailing from amalgamation was digested with aqua regia, evaporated to dryness, dissolved in strong HCl, evaporated again, and taken up in HCl. The residue was filtered off and assayed for Sn in the usual way. The content of soluble tin in the form of silicate was 12.06% and of insoluble tin as $SnO_2$ retained in the residue, 0.58%. Referred to the whole sample, these figures are 11.35% and 0.54%, respectively.

Adding to these figures those found in the magnetic product, it will be seen that the total content of tin as reduced barrilla in the original sample is 0.58%; and of soluble tin, presumably as silicate, 11.93%. By adding the partial tin content, a total of 14.43% is derived, instead of 14.59% found directly.

This method of analysis is open to discussion on one point. The metallic tin contained in the magnetic product has not been determined, and is probably accounted for as silicate. This could have been avoided by amalgamating the whole sample before magnetic separation, but an objection against this is that the sample is then reduced to so fine a state that magnetic separation becomes difficult. The error is small, because the non-magnetic material carried away in the magnetic product is about 37% of the weight of the latter, or 2.1% of the whole sample. If great accuracy be required, the residue, after treating the magnetic product with dilute acid to extract the iron, can be added to the non-magnetic product and amalgamated with it.

## Future of Cornish Tin Mining*

A deputation of the Joint Industrial Council of the Tin Mining Industry of the United Kingdom, headed by C. A. Moreing, was received recently by the Parliamentary Secretary to the Board of Trade. The object of the deputation was to secure such financial assistance as will enable mines to continue working, and so bridge over the reconstruction period. Meanwhile, it is requested that a state inquiry shall be held, as recommended by the committee on production. In the statement of case to be presented by the deputation for submission to the inquiry, the reasons for state assistance are summarized as follows:

1. The necessities of the state in the matter of labor for the army, and in the control of the prices of tin, have helped to bring the industry to its present parlous condition.

2. The high prices of coal and materials, the former mainly due to the increase of wages of coal miners authorized by the government coal controller, have had a serious effect on the industry, and have prevented the tin miners from being paid a wage adequate to meet the increased cost of living.

3. The price of tin for approximately the first two and a half years of the war was less than its pre-war selling price, and the subsequent rise was checked by government control and reduced to such a figure that tin cannot be produced in Cornwall under existing conditions other than at a heavy loss, except in the isolated cases of abnormally rich lodes and with the assistance accorded by the sale of the byproducts—wolfram and arsenic.

4. That in each recent case of an inquiry by the government committee into the condition of the industry and the causes of the existing state of affairs, evidence has been adduced sufficiently strong to show the necessity for practical support and confirming the statement now made.

5. That the government man is now being provided with out-of-work donations, which could be spent to better advantage in another way.

6. Unless the mines now working can be maintained, the labor now employed must in due course be thrown out of work, and no work will be ready for the miners now being demobilized. In that event it is clear that large sums of money will have to be expended by the state as unemployment benefits.

It was stated on behalf of the deputation, that in time of war or other emergency the supply of tin, and in some cases the production of wolfram and arsenic, were absolutely essential. A regular and increasing quantity could be obtained from Cornwall, without danger of delay or loss to which supplies from abroad were subject through submarine warfare. The deputation further submitted that in normal times approximately 8000 persons were engaged in the industry. In 1917 this number was reduced by enlistment to approximately 5000, and upon the return of the men from military service they would be thrown into unemployment unless measures are taken to maintain the industry at pre-war level.

*Abstracted from the *Mining Journal*, Feb. 1, 1919.

### Efficiency

It ain't a senseless hoardin'
Nor stinting of our need,
But efficiency in spendin'
That should become our creed.

It ain't some money set aside
On impulse once awhile,
But steady savin' day by day
That builds the solid pile.

—S. V. Perlman.

"Always Taking Out of the Meal Tub and never putting in soon comes to the bottom."—(Benjamin Franklin). Buy W. S. S.

# Correspondence and Discussion

## The Professor and the Anaconda

Dr. Louis Levine, by publishing his essay on "The Taxation of Mines in Montana," through B. F. Huebsch (price $1), got into trouble with his superiors in the University of Montana, who had refused publication of the essay as a university document. Dr. Levine has received much sympathy from people who have viewed him as a David fighting a Goliath, a professor boldly challenging an anaconda, but who probably did not take the trouble to read his essay. As is not uncommon in such cases, few paused to consider whether the president (or chancellor) may be right and the professor wrong.

Dr. Levine did me the honor to cite me as an authority several times during his essay. Indeed, it may almost be said that an economic paper by me on "Anaconda Finances," which he characterizes as "a careful and penetrating analysis," is the Rosetta stone from which he draws his deductions as to the value of the Anaconda properties. The fact that he consistently misspelled my name in his text, but once used it correctly in a footnote, however, with an incorrect reference to the publication of my paper that he cites, did not predispose me toward him for accuracy. Let me say, moreover, and at once, that I do not sanction his derivatives from my analysis.

Dr. Levine's essay is in part a well-considered study of the subject of mine taxation in general, in which there is much to commend, and partly it has the aspect of a campaign document against the Anaconda Copper Mining Co., in which it loses all scientific character and is marred by citations to the literature of stock brokers, and other unworthy references. The culmination of the essay is in Chapter 6 on "The Anaconda Copper Mining Co." At the end of that long chapter, which is replete with tables of figures, Dr. Levine says: "All the calculations made in this chapter can be summarized in a few lines. During the five years 1913-1917, the average assessment of the A. C. M. Co. was 6.6% of the total assessment of the state, and the company paid 6.7% of all taxes collected in the state. The company was assessed at about 25% of the true value of all its properties in Montana, while agricultural land is reported to have been assessed at 35%, livestock at 45%, bank stock at 60 per cent."

Dr. Levine assumes the fixed and current assets of the company as of Dec. 3, 1916, as $224,014,841, as reported officially by the company, and uses that figure in his table of comparison between assets and assessment. There is a relatively small and immaterial error in his total, which may be typographical or clerical, although it is repeated, but not so lightly may be passed over his omission to state that upon the same date the debts of the company were approximately $54,000,000, wherefore its net assets were about $170,000,000. Those net assets included holdings in other companies, not in Montana, and stocks of metals, etc., that were largely in plants of the company outside of that state. My own analytical figures as to the value of the property of the company in Montana are twisted into shapes that I do not recognize. I stated specifically that the mines and metallurgical works of the company in Montana came to about $47 per share of the company's capital stock, which would make a total of about $110,000,000. Adding to this the value of the timber lands, the total would be about $115,000,000 and the state assessment of $55,600,000 would be about 48% of that. An additional allowance for the material, merchandise, etc., carried by the company in Montana would not materially reduce that percentage, which manifestly is a very different thing from what Dr. Levine calculates.

The Chancellor of the University of Montana may not have examined Dr. Levine's manuscript in just this way, and may have merely considered its general tone, but without any doubt he acted upon a true instinct when he refused its publication as a university document.

W. R. INGALLS.

New York, Mar. 20, 1919.

## About Spanish

A discussion, the subject of which is "About Spanish," appears in your issue of Jan. 25, and I beg to take exception to almost everything George Washington (aged 10) has to say about this matter. For his view to become established among our younger mining men who may come to Spanish America would undo years of work in trying to make all employees and future employees feel the necessity of knowing how to talk Spanish.

I know the manager of the huge copper mine to which he refers, and, although he was not proficient in Spanish when he arrived, he realized the necessity of instituting compulsory Spanish classes in his organization. Spanish instructors were placed on the payroll, and all the staff asked to attend—convenient hours having been arranged. Conferences on this subject were held, and it was the opinion of all present that a man who could not talk to his men was fully 30% less efficient than the man who could.

The manager of the next biggest copper mine in South America, in cabling for men to the New York office, used words that have since become familiar to South American mine operators. He said "Send me men with guts, go and *habla*"—"guts" meaning fearlessness, "go" meaning a keen, snappy, ambitious interest, and *habla* a working knowledge of Spanish. It is usually understood that the New York office will not send a chimney sweep if one asks for a blacksmith, and it is their business to see that whoever is sent is proficient in his line. In addition to this proficiency, he should have the qualifications embodied in the three little words mentioned.

The manager of the third biggest copper mine in South America said, "It is unfortunate that more of our staff are not fortified with a knowledge of Spanish, as it makes such a difference in handling their men." The manager of the fourth biggest copper mine in South America speaks Spanish splendidly and requires no middleman to carry on his conferences with the President of the Republic or with his legal advisors. He takes nothing for granted, but asks questions of this man or

that; and Georgie must admit this a decided advantage. His views on this subject are identical with the others.

These men are not very well camouflaged here, so I would ask George, and anyone else who has any doubt about this thing, to write to some of the men who know, so as to get the matter straightened out before some novice really swallows the impression set out in Georgie's discussion "About Spanish."

I don't believe that all the children in the world should study Spanish, as far as that goes, but let me state here and now that if any American student mining engineer can cram in an hour of Spanish on his card, let him do so by all means. If it turns out that he goes to Russia, this grounding won't help him much, but the chance that he might come down here is such that the little effort is worth while.

I am talking purely from a standpoint of mining, and readers can draw their own conclusions as to the same argument along other lines of endeavor. Little Georgie has stated that his axioms "can be proved" and that "he is here to do it." I frankly admit that he has made no impression on those of us down here who are digging copper ore; and I feel perfectly safe in saying that the profession at large in Spanish America is of the same opinion. "EXPERIENCE."

South America, Feb. 16, 1919.

## Calibration of Thermocouples

In the article by C. S. Crouse on "Calibration of Base-Metal Thermocouples" in the *Journal* of Mar. 8, page 433, I note an error in the manner of applying the cold-junction correction of the precious-metal thermocouple. As is well known from fundamental considerations, the temperature of the cold junction cannot be added to the temperature as indicated by the galvanometer without applying a correction factor which will depend upon the type of couple in use and will vary both with the cold-junction and with the hot-junction temperatures. This factor is necessary because there are only certain couples having a linear relation between the temperature and the electromotive force. For example, in the case given, with a cold junction of 16.8° C. (assuming that this is correct, instead of 87° F., as given) and hot junction near 800° C., the factor would be about 0.5 for Pt, 90Pt = 10Rh couples. Thus, the corrected reading for the rare-metal couples would be 777.1° + (0.5) (16.8) = 785.4° C., instead of 739.847° C., as given. For base-metal couples, the cold-junction correction factor will vary from 1.5 to 0.3, depending upon the type of couple and the temperatures involved. On account of the magnitude of the normal errors in the use of base-metal couples, the cold-junction correction factor is often neglected when using these couples.

Further on in Mr. Crouse's article, he states that the correction of the base-metal couple is 10° F., and that this must be deducted from any temperature measured with this couple. In some cases this would lead to correct results, but in many cases a couple reading 10° F. high at 800° C. may indicate correctly at a lower or a higher temperature.

Mr. Crouse also falls into the common indiscretion of using figures that purport to be more accurate than the data on which the figures are based. Thus, 87° F., the cold junction of the precious-metal couple, was probably measured on a thermometer accurate to the nearest half degree, yet this figure is rendered into 16.775° C. (it should be 30.5° C.). The first decimal place is all that is needed in the progress of the calculations to arrive at calibration figures that will be accurate to the nearest degree. This is a greater degree of accuracy than is usually obtainable when using base-metal couples at high temperatures. W. F. DIETRICH,

Assistant Professor of Mining.

Stanford University, California, Mar. 14, 1919.

## Regarding the Mine Physician

The discussion following the reading of the paper, "Prevention of Illness Among Mine Employees," by Dr. A. J. Lanza, at the February meeting of the A. I. M. M. E., suggests a point that is worthy of the attention of mine operators. It developed that an inquiry among a number of mine doctors disclosed the fact that the greater number of those questioned admitted that they had not at any time visited the underground workings of the properties operated by the companies by which they were employed. Briefly, the situation is probably as follows: A miner is injured underground, perhaps seriously. The physician is called to the mine office, where he awaits the arrival of the injured man, who is brought to him by means of such facilities as are afforded at the mine. Perhaps the doctor remains at his office or hospital and the man is taken there. In any event, it would appear that the convenience of the doctor is given the most consideration.

The mine may boast of an excellent first-aid hospital, a well-trained corps of first-aid men and be otherwise well able to consider the condition of the injured man. A question that naturally arises is: What influence does the place of the accident and the general conditions surrounding the work of the injured man have upon the nature of the injury? The mine authorities are doubtless competent to pass on the physical aspects of the accident; that is, their familiarity with the methods of work that are employed and their knowledge of the surrounding territory are sufficient to enable them to make a complete analysis of certain conditions, but are they fitted to give consideration to all of the factors that contributed to the accident? And, frequently, is there not some cause, unknown to the mine management and with which the physician may be familiar, that, by reason of his experience, he is able to throw light on?

The argument of "too many cooks" may be applied, perhaps, in rebuttal of the suggestion, but it would seem that further discussion and a full consideration of all facts would more nearly approach the desired result, namely a solution, which would eliminate the possibility of the occurrence of a similar accident.

Physicians, as a rule, desire to make themselves familiar with the surroundings of their patients, so that they may suggest certain corrective measures which will bring about the prevention of disease or shorten the period of disability. And should not this principle apply to the mine physician as well? We have excellent examples of research work along preventive lines that have been carried out by Government doctors, but these have not been accomplished by laboratory methods or consultations alone, but by an actual contact with all the contributive factors. The mining industry owes its success to constructive suggestion, experimentation, and consideration of all ideas which bear directly or indirectly on its operations, and it would seem that great good is to be gained by securing the opinions of mine physicians as to underground conditions.

New York, Mar. 17, 1919. D. E. CHARLTON.

# Ore Dressing and Metallurgy

*Rock-breakers of the swinging jaw type are usually employed in small or medium-sized plants, especially in isolated localities where simplicity of design is a factor which tends to insure the minimum of interruption and expense. Two practical notes on the subject are given.*

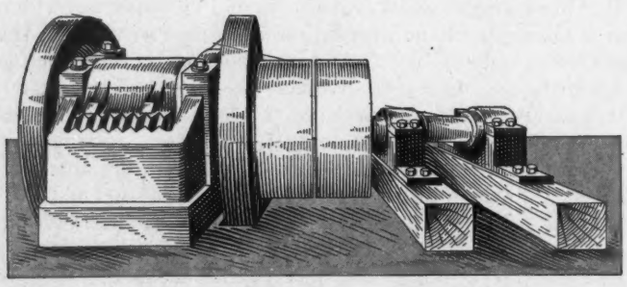
*The measurement of water or solution is often necessary at many stages of operation of a hydrometallurgical plant. Meters are not always satisfactory with corrosive liquids or with those which deposit an incrustation on parts of the apparatus. A description of an orifice bucket is here presented, which combines simplicity with a fair degree of accuracy, accompanied by a chart showing the results obtainable from a 20-in. bucket, measuring up to about 6000 tons per day. For smaller amounts a certain number of the holes may be plugged, and additional curves drawn.*

## Trouble With Rock-Breaker Pitmans

Heating of the pitman in the swinging jaw type of rock breaker is common, and usually results from faulty or uneven bearing surface, inefficient lubrication, dirty lubricant, and unprotected grease cups or oil reservoirs. Troubles arising from such causes may be reduced to a certain extent, but, nevertheless, the heating usually persists, despite ordinary precautions and normal attention. Water-cooled pitmans are desirable, and there is no particular reason why they should be considered only with large sizes and types of such machines. As a matter of fact, conditions around the primary crushing department of a small plant are usually conducive to overheating of bearings, and the duty expected is often continuous and, comparatively speaking, severe.

## Idle Pulley for Rock Breakers

Rock breakers in small mills are often placed in out-of-the-way positions, and attention is paid to their condition only when they are in use. It usually happens that primary rock crushing is practiced during a small proportion of the 24 hours. For a part of the remainder of the time, at least, the crusher may operate without load, or the driving belt may be running over an idle pulley on an extension of the crusher shaft. Under the conditions often prevailing, the duty is usually severe, and the belt has to be kept tight. When running on the idle pulley the strain is still there, in fact to such a degree that it is found difficult to eliminate friction by means of ordinary lubrication.



UNCONNECTED IDLER FOR ROCK BREAKER

Trouble from such a cause may be reduced or minimized to a large extent by the provision of an idle pulley keyed to a separate shaft running in separate bearings, as shown in the accompanying cut. The shaft is collared so that the idle pulley is a small fraction of an inch from the crusher driving pulley; and the transfer from the one to the other can be made as easily as if both fast and loose pulleys were on the same shaft.

## Orifice Bucket for Measuring Water*

The orifice bucket provides a convenient method of measuring water by simple and inexpensive means. It is a cylindrical vessel into which water to be measured falls vertically, and passes out through a number of holes or orifices in the bottom. A vertical glass tube placed just outside the bucket is connected to the sides near the bottom, and the height of the water in the tube indicates the head on the orifice.

The orifice bucket was devised for the purpose of measuring the discharge of several artesian wells pumped by means of air lift, the water from each of which discharged into a separate cistern or small reservoir through a vertical pipe. In each case the water left the pipe with considerable blast and momentum. Several possible methods for the measurement of the discharge were considered, but were thought to be impracticable for various reasons, or inapplicable for the particular case. After some preliminary laboratory experimenting, an orifice bucket was devised which served satisfactorily in determining the discharge from each of the wells. It was at first thought that the water would enter the bucket with such a blast that entrained air would enter the vertical glass tube and cause trouble in determining the height of water in the bucket. There was, however, no difficulty from this cause.

The orifice bucket has also given satisfaction in tests made to determine yields of well pumps of the reciprocating type, where simplicity of construction and portability are desirable, and where extreme accuracy is not of great importance.

An illustration of the most elaborate orifice bucket used in the experiments is shown herewith, the capacity of which is about 1000 gal. per min. It contains a checkerwork of vertical tubes through which the water flows in passing to the orifices. The gage glass which indicates the head on the orifices is connected to a piezometer ring or chamber around the base of the bucket. The pressure of the water in the bucket is

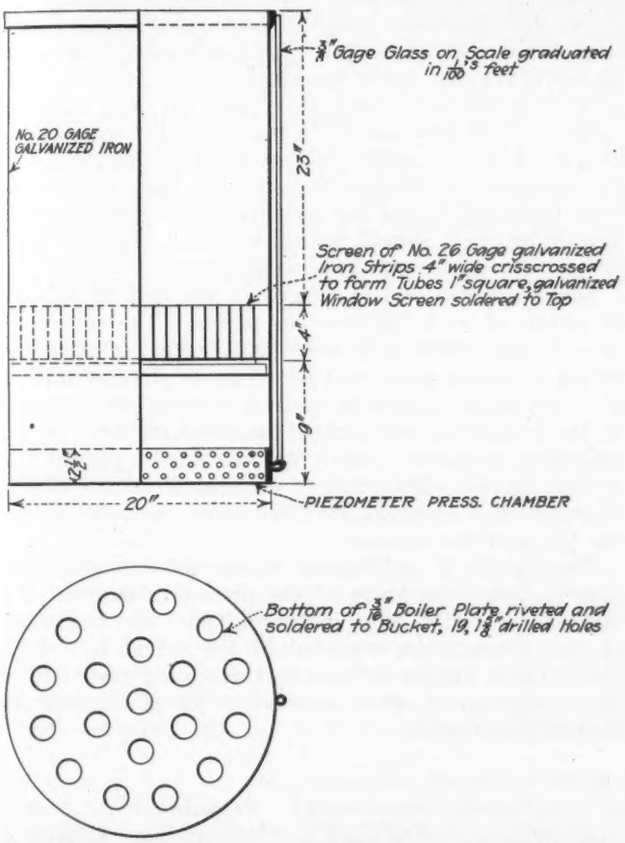
*Abstracted from *Bull.* 105, issued from the Engineering Experiment Station of the University of Illinois.

transmitted to the piezometer chamber through a large number of ½-in holes. The bottom of the bucket consists of $\frac{3}{16}$-in. boiler plate in which nineteen $1\frac{5}{8}$-in. circular holes are drilled.

The calibration curves for this orifice bucket are also shown, for all holes open and for 10 holes open. The discharge for any other number of orifices open may be found with a fair degree of accuracy from the equation

$$Q = 32.7\ n\ \sqrt{h}$$

in which $q$ is expressed in gal. per min., $n$ is the number


¾" Gage Glass on Scale graduated in 100ths feet
No. 20 GAGE GALVANIZED IRON
23"
Screen of No. 26 Gage galvanized Iron Strips 4" wide crisscrossed to form Tubes 1" square, galvanized Window Screen soldered to Top
4"
9"
12½"
20"
PIEZOMETER PRESS. CHAMBER
Bottom of 3/16" Boiler Plate riveted and soldered to Bucket, 19, 1⅝" drilled Holes

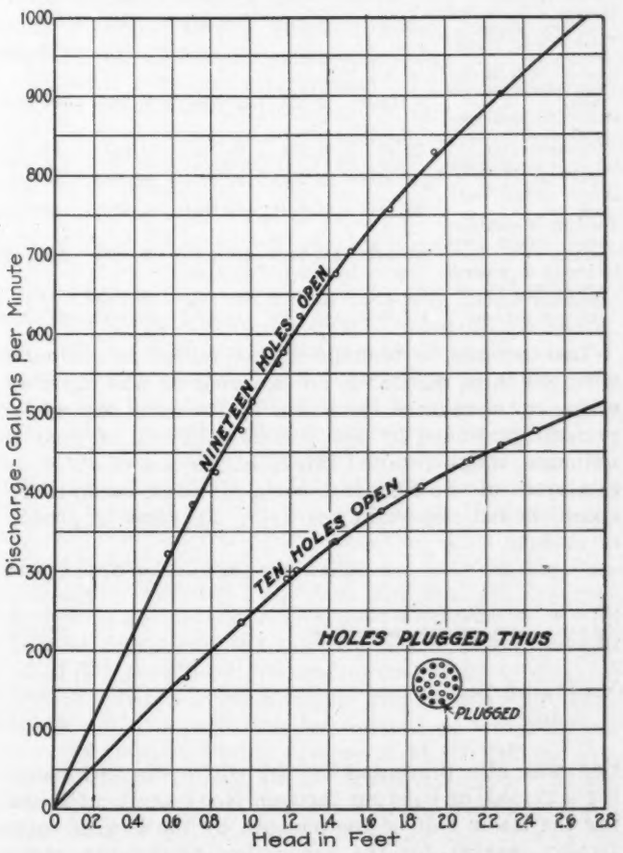
TWENTY-INCH ORIFICE BUCKET HAVING 19 ORIFICES

of holes open, and $h$ is the head on the orifices in feet. The average coefficient of discharge for the $1\frac{5}{8}$-in. orifices of this bucket is 0.61.

The curves shown were obtained when the bucket was supported firmly in an upright position, with the stream to be measured discharging vertically in the center of the bucket and with the free fall into the bucket small. The velocity of the inflowing stream, furthermore, was not high (2 or 3 ft. per sec.), thereby causing but little agitation of the water in the bucket. Experiments, however, in which more or less variation from these conditions were allowed, indicated that no serious errors resulted.

The conditions under which the discharge of water may be measured are so varied, and the purpose or aim in determining the discharge is subject to so much variation in different problems, that nearly all the many common methods of measuring water have a restricted field of usefulness, and some methods apply only to special conditions. The orifice bucket is designed to meet such special conditions. It is peculiarly adapted for the measurement of water where a device which is portable (light in weight and of small size), simple in construction, and low in cost is an essential requirement. The measuring capacity, moreover, covers a considerable range. The orifice bucket is particularly fitted for the measurement of water when it discharges with considerable blast and momentum from the end of a vertical pipe, in such a manner that the spray covers the entire surface of the water in the bucket, as in the case of air-lift pumping. When so used the orifice bucket gives results which should be correct within 5% if the proper precautions are observed in its use, as is shown by the calibration curves, and correct within 10% for the more unfavorable conditions to be met in the field.

The highest accuracy is obtained when the orifice bucket is supported rigidly in an upright position with the center of the discharging stream vertically over the center of the bucket. The free fall of the water should be as small as possible, and the velocity of the




CALIBRATION CURVES FOR 20-IN. ORIFICE BUCKET WITH 19 ORIFICES

water as it enters the bucket should not be high, unless the stream is distributed, so as to avoid high local velocities in the bucket. The device, however, gives satisfactory results even when there are considerable deviations from these desirable conditions and is applicable under conditions in which other systems may not be adapted.

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**Turning 54-in. Diameter x 20-in. Face Rolls,** without the use of a lathe, is done in the Southeast Missouri lead district, according to A. P. Watt, in Bull. 130 of the A. I. M. E. The cost of turning in the roll house by this means was $5 to $8 per shell, as compared with over $13 when the rolls were sent to a machine shop with a lathe sufficiently large to handle them.

# Company Reports

## Butte & Superior Mining Co.

The report of operations of the Butte & Superior Mining Co. for the fourth quarter of 1918 contains the following information:

OPERATIONS OF BUTTE & SUPERIOR MINING CO., 1918

| | Fourth Quarter | Third Quarter | Second Quarter | First Quarter | Total |
|---|---|---|---|---|---|
| Tons of ore milled | 110,039 | 108,182 | 114,716 | 135,877 | 468,814 |
| Average zinc content (per cent.) | 15.501 | 15.647 | 16.242 | 16.233 | 15.928 |
| Average silver content (oz. per ton) | 6.515 | 6.331 | 6.154 | 6.346 | 6.335 |
| Zinc concentrate produced (tons) | 30,391 | 29,683 | 32,653 | 42,814 | 135,543 |
| Average zinc in concentrate (per cent) | 52.635 | 51.9708 | 51.882 | 49.181 | 51.217 |
| Total zinc in concentrate (lb.) | 31,994,804 | 30,852,947 | 33,881,677 | 42,112,311 | 138,841,739 |
| Average silver in zinc concentrate (oz. per ton) | 21,047 | 20.500 | 19.763 | 19.209 | 20.029 |
| Mill extraction (per cent. of zinc. in ore in concentrates) | 93.785 | 91.133 | 90.925 | 95.462 | 92.965 |
| Direct mining costs (per ton) | $7.9478 | $8.2078 | $7.0494 | $5.9110 | $7.1916 |
| Direct milling costs (per ton) | $3.2443 | $3.0145 | $2.8841 | $2.6082 | $2.9188 |
| Total direct costs (per ton) mining and milling | $11.1921 | $11.2223 | $9.9088 | $8.5192 | $10.1104 |
| Indirect, or general, costs (per ton) exclusive of freight | $0.6716 | $1.1134 | $1.5363 | $1.2182 | $1.1435 |
| Total cost (per ton) | $11.8637 | $12.3357 | $11.4451 | $9.7374 | $11.2539 |

The increase in tonnage of ore milled as compared with the third quarter is not as great as was expected, owing to the reduced forces during the early part of the period, occasioned by the serious epidemic of Spanish influenza, which resulted fatally in the case of 30 of the employees of the company, some of whom occupied responsible and important positions. Increase in production was also prevented by the entire discontinuance, for a period, of hoisting through No. 1 shaft, and, during the latter half of the quarter, by the lack of satisfactory market for the production during the period following the signing of the armistice.

The No. 2 shaft was completed to a depth of 1900 ft. (from which elevation it is expected that it will be completed to the 2050 ft. level within the next three or four months), and the pumping equipment on the 1200-ft. level at shaft No. 1 was removed to the new pump station at shaft No. 2 and put in satisfactory operating condition. With the somewhat curtailed output this has permitted the discontinuance of hoisting through No. 1 shaft and the hoisting of all the ore through the new No. 3 shaft, from the ore bins of which it is delivered to the new coarse-crushing plant. This change in practice will result in material economies in operation, so that, in spite of a reduced scale of production, it is expected that some reduction of mining and milling costs will be brought about in the immediate future.

Underground development work resulted in the discovery of no new orebodies, but, nevertheless, has shown favorable results in the further development at greater depth of the orebodies already known on the Four Johns and Raymond claims, which adjoin the Black Rock claim and workings to the eastward. These are known to continue below the stopes on the 1300-ft. level, of good grade and extent, to a depth at least as great as the 1800-ft. level, at which point, and below, developments are not yet sufficiently extensive to demonstrate the character or extent of the orebody. The ore reserves were increased during the period, and development work now in progress should, within the next three months, add a material tonnage to such reserves.

Some decrease was evidenced in the cost of mining as compared with the previous period. The supply of labor is now plentiful, and the improvement in efficiency which is taking place will in all probability permit of some reduction in mining costs in spite of the increase in the proportion of overhead expenses incident to the reduction in output, which will, no doubt, prevail for several months. The grade of ore mined and milled was maintained at approximately the same average as during the previous quarter.

The results of milling operations showed a marked improvement over those of the preceding quarter, the extractions of zinc being increased 2.66% and the grade of zinc concentrate improved to the extent of 0.65% zinc. There was an increase in the milling costs due to the absorption of some unusual items of expenditure during this period.

FINANCIAL RESULTS OF OPERATIONS OF BUTTE & SUPERIOR MINING CO., 1918

| | Fourth Quarter | Third Quarter | Second Quarter | First Quarter | Total |
|---|---|---|---|---|---|
| Net value zinc concentrate at mill | $983,362.32 | $1,122,021.43 | $1,124,894.67 | $1,405,271.39 | $4,635,549.81 |
| Net value lead concentrate and residues | 398,352.34 | 342,225.75 | 302,609.10 | 236,517.69 | 1,279,704.88 |
| Miscellaneous income | 20,262.53 | 15,702.11 | 13,815.63 | 9,291.15 | 59,071.42 |
| | $1,401,977.19 | $1,479,949.29 | $1,441,319.40 | $1,651,080.23 | $5,974,326.11 |
| Operating costs, taxes, etc | 1,305,470.56 | 1,334,501.53 | 1,312,932.53 | 1,323,098.70 | 5,276,003.32 |
| Profits | $96,506.63 | $145,447.76 | $128,386.87 | $327,981.53 | $698,322.79 |

Financial results of operations for the fourth quarter, as compared with the other quarters of the year, are shown in the table.

The motion to dismiss the appeal in the apex litigation, which was noted for Nov. 18, was submitted on that date, and the Supreme Court of the United States on Dec. 10 set the case for hearing upon all matters for Jan. 6, 1919, since which date the case has been argued and is now under submission before the United States Supreme Court, and it is entirely probable that no further steps will be taken in this matter until a decision has been rendered.

In the flotation litigation the Supreme Court of the United States granted the application of Minerals Separation Ltd., *et al*, for a writ of certiorari, and the case is now pending before that court. The Minerals Separation Co. made application to the court for an order to restrain the Butte & Superior Mining Co. from disposing of its assets pending the actions on the mandate of the Supreme Court, at the same time moving

the court to advance the cause for a hearing. On Jan. 6 the Supreme Court denied the motion for the restraining order and set the case for hearing on Mar. 3, 1919.

It is expected that, before the next quarterly report is issued, the Supreme Court of the United States will have decided the Elm Orlu case, and that during the succeeding quarter a decision will be rendered by that court in the Minerals Separation case.

## Superior & Boston Copper Co.

The report of the Superior & Boston Copper Co., operating at Copper Hill, Ariz., for the year ended Sept. 30, 1918, states that receipts totaled $352,500.30 and expenditures $364,703.30. Deducting the deficit for the year from the balance of Oct. 1, 1917, there remains on hand Oct. 1, 1918, a balance of $129,374.35.

Principal operations during the year consisted of development work at the east end of the mine at the 800 and 1000 levels and also the reopening of the 1200 level. Development includes the following: Winzes, 47 ft.; drifts and crosscuts, 1504 ft., and raises, 350 feet.

## Victoria Copper Mining Co.

The Victoria Copper Mining Co. at Victoria, Mich., reports that during 1918 there was produced 1,533,536 lb. of refined copper, or 79,104 lb. less than in 1917. Operations for the year (including expenditures of $17,045.52 for construction and development of water power) show a profit of $31,405.44, which, added to surplus and deducting supplies and stock in store at the mine, leaves a balance of $238,227.53, which amount is represented by cash, Liberty bonds, and copper on hand figured at 18c. per pound.

A total of 120,616 tons of rock was hoisted. 106,730 tons of which was stamped and produced 2,451,413 lb. of mineral. Drifts driven totaled 2447 ft.; crosscutting, 140 ft.; raising, 229.5 ft., and shaft sinking, 30.5 feet.

## Arizona Copper Co., Ltd.

The Arizona Copper Co., Ltd., reports for the year ended Sept. 30, 1918, that the surplus, after the year's business and after paying preferential dividends of $119,221.15, amounted to $1,333,036.20. The directors recommended that a dividend for the year to Sept. 30, 1918, be declared on the ordinary stock at the rate of 72c. per share, and this will absorb $1,107,994.15. Production for the year was 40,442,000 lb. of copper, of which 27,262,000 lb. was refined, and the remainder, 13,180,000 lb., was sold as bessemer metal. Total ore mined was 1,095,568 tons, which yielded 35.08 lb. of copper per ton.

Prospecting with churn drills was begun to determine the character of the ground east of the Coronado adit, and during the year about 6000 ft. was drilled. Among the improvements made were: Retimbering of No. 6 shaft and equipping same with water sprays for fire protection; the laying of a new pipe line from Morenci to Coronado; extension of the King incline 400 ft. down to the level of the Torpedo tunnel, and the installation of a rock crusher at the lime quarry.

No. 6 Concentrator, at Morenci, treated 935,861 tons of ore, having an average grade of 2.36% copper. During the year 12 motors of 125 hp. were installed in the grinding department, 12 Allen thickening cones, 12 Dorr classifiers, 8 Callow flotation cells, and several large Dorr thickening tanks for treatment of concentrates and tailings. No. 4 Concentrator, at Clifton, treated 113,257 tons of ore, having an average grade of 2.13% copper. Changes were made in the flotation department and Deister tables installed to replace the old vanners. The total amount of new material smelted during the year was 213,336 tons.

## Vindicator Consolidated Gold Mining Company

The report for the year ended Dec. 31, 1918, of the Vindicator Consolidated Gold Mining Co., operating in the Cripple Creek district of Colorado, reflects the difficulties of gold mining in times of high prices, as the value of the product remains fixed, though labor and supplies advance. In addition, the Cripple Creek district suffered severely from the influenza epidemic.

Development in 1918 amounted to 5112.5 ft., of which 2899 ft. was driven by lessees. Of this, 2622 ft. was drifting and 2490.5 cross cutting. Early in 1918 development work was discontinued on the 20 or bottom level of the Golden Cycle shaft. On this level a total of 4240 ft. of development has been done, without exposing ore of commercial grade. This level is 2150 ft. below the shaft collar.

There are possibly bodies of ore at a greater depth, but it is the opinion of the management that there could not be enough commercial ore to warrant the expenses of sinking and exploring. Ore reserves were greatly depleted during the year covered by the report. On Jan. 1, 1918, they were 255,500 tons; on Jan. 1, 1919, reserves were 104,230 tons. The 19th and 20th levels were cleaned up, all pipe, tracks, pumps, and other materials removed, and pumping was discontinued on June 27, 1918. The workings filled rapidly, and the water continued rising after the level of the Roosevelt drainage tunnel was reached, so that on July 27 pumping was resumed from the 18th level. This appears to indicate that an impervious dike lies between the Vindicator and Portland properties, and that the drainage tunnel will not drain the former.

Closer picking of the shipping ore and careful sorting of the rejects before sending them to the flotation plant resulted in great savings. During the year, 230,304 tons of company ore was hoisted, of which 21,392 tons was shipped, having a value of $1,166,295 and giving net returns of $1,015,917. On lessees' account, 53,463 tons was hoisted, having a gross value of $463,514 and a net value of $321,098. A total of 222,626 tons of ore was sent to the flotation plant, having a value of $2.13 per ton, from which 176,623 tons was screened out, with an average value of $1.42, and 46,003 tons, of an average value of $4.18, was sent to the flotation-plant crusher. Concentrates recovered totaled 6029 tons, of a value of $30.20 per ton.

The company purchased the Ferro Alloy Co., at Utah Junction, Colo., and a chrome mine 23 miles southeast of Glenrock, Wyo., during 1918. The life of the Victor mines will apparently be short, and active search is being carried on for a new property. Five properties were thoroughly examined in 1918, but none was taken over. The Ferro Alloy plant is devoted solely to ferrochrome making, about 100 tons per month being produced. Net working capital increased from $136,811 at the close of 1917 to $542,204 at the close of 1918, but the statement of ore reserves as given above shows that this was at their expense.

# Industrial News from Washington

BY PAUL WOOTON, SPECIAL CORRESPONDENT

## War-Mineral Claims Offer Problems

No awards will be made by the War-Minerals Relief Commission until after the time limit for filing claims has passed. This is made necessary because of the limited appropriation available. As it is possible that the total claims may exceed $8,500,000, it is the opinion of the commissioners that it would be unfair to allow the first claims established, as others of equal merit, coming at a later time, could not be settled because of exhaustion of the appropriation.

A number of claims have been filed with the commission, but they will not be considered until the questionnaire has been filled out in accordance with the regulations which have been adopted. At this writing, no claims filed under the regulations have been presented.

It is expected that field men will have to make a personal examination of most of the claims coming within the purview of the act. An arrangement has been made with J. E. Spurr, the head of the War-Minerals Investigation Section of the U. S. Bureau of Mines, whereby his field force will make the necessary examinations. Field men already have been dispatched to investigate the claims of the Chestatee Pyrite and Chemical Corporation, in Georgia, and of the National Pyrite and Copper Co., in Alabama.

It is apparent that the difficult problem facing the commission is the securing of a business basis on which to distinguish between the claimants who made expenditures at the request of Government agencies and those who entered upon a mining venture for speculative purposes.

## Steel Prices Lowered

To the surprise of most persons interested, the new Industrial Board of the Department of Commerce accomplished something distinctly tangible when an agreement was reached with the steel manufacturers which cut the price of steel fully 20% below the war prices and from 10 to 14% under the post-war prices which the steel industry voluntarily had placed in effect. The price of ore is to remain the same until the projected reduction in freight rates becomes effective. No negotiations with the producers of other metals are expected at this time, according to a statement given out at the offices of the Industrial Board.

One of the surprises of the meeting is that the prices are to be maintained for a year. This is contrary to precedent in the steel industry, where it has been the practice to revise prices quarterly. One of the most interesting aspects of the negotiations is the legal phase. There is every reason to believe that assurances have been obtained from the Department of Justice that agreements as to prices when the Government is a party are not regarded as violating the Sherman Law. The official statement regarding the steel prices, which was issued Mar. 21 by the Industrial Board, follows in essential particulars:

The board is asking industry to coöperate in taking the first step and voluntarily make temporary sacrifices in the interest of all, and has asked the iron and steel industry, because of its fundamental importance, to be the first to act, and the board is highly gratified with the spirit in which it has responded.

It is fully understood and expected that the present wage rates or agreements will not be interfered with, the approved prices having this in view.

The reduction in the price lists may involve the necessity of some high-cost plants either shutting down temporarily or running at a loss for a period, but it is expected that with an increased volume of business, soon to be developed, a reasonable return to the average and better than average producers will be afforded. In view of the higher costs developed throughout the world as a result of the war, a return to anything like pre-war prices is regarded as out of the question. It is expected that other industries, as well as the consuming public and labor, will recognize their obligations in the circumstances and coöperate in the same generous spirit as has the steel industry.

Judge E. H. Gary, of the U. S. Steel Corporation, in announcing the new prices, said in part:

The objects to be secured are a revival and stabilization of business by establishing a reasonably low basis of prices which would be satisfactory to the consuming public, and yet, so far as practicable, would yield a moderate and reasonable return to the investors where they are entitled to it in the application of sound business principles; and at the same time would not disturb wages rates or interfere with wage agreements; and, further, having determined upon prices which it is expected will not be reduced during this year, it is believed that the volume of business will be promptly increased and that furnaces and mills will be operating at a largely increased capacity, thus giving employment to a correspondingly increased number of employees.

It has been necessary to ascertain and scrutinize all the facts and figures in order to prevent any injustice, and this has been the occasion for considerable discussion and some differences, but as a final result of the conferences which have taken place during the last two days and before, the committee appointed to represent the entire iron and steel industries joined in the report which was made to the Industrial Board.

While in the opinion of some of the manufacturers the board has insisted upon some changes in the schedule submitted before approving the same, yet the iron and steel committee are convinced that the members of the board have been governed solely with the intention of protecting and promoting the best interests of the public, the investors of capital, and the employees, without discrimination, and that the action of the board has been wise and just.

The price list and reductions submitted and approved by the Industrial Board are in part as follows:

PRICE LIST OF IRON AND STEEL PRODUCTS APPROVED BY INDUSTRIAL BOARD

| | Nov. 11 Price | Present Price | New Price | Reductions From Nov. 11 | Reductions From Pr eset |
|---|---|---|---|---|---|
| Pig iron, basic | $33.00 G.T. | $30.00 | $25.75 | $7.25 | $4.25 |
| Billets, 4-in. | 47.50 G.T. | 43.50 | 38.50 | 9.00 | 5.00 |
| Billets, 2-in. | 51.00 G.T. | 47.00 | 42.00 | 9.00 | 5.00 |
| Merchant bar, base | 2.90 G.T. | 2.70 | 2.35 | 11.00 N.T. | 7.00 N.T. |
| Structural, base | 3.00 G.T. | 2.80 | 2.45 | 11.00 N.T. | 7.00 N.T. |
| Light rails | 3.00 cwt. | 2.70 | 2.45 | 11.00 N.T. | 5.00 N.T. |
| Rails standard bessemer | 55.00 G.T. | 55.00 | 45.00 | 10.00 | 10.00 G.T. |
| Rails standard O.H. | 57.00 G.T. | 57.00 | 47.00 | 10.00 | 10.00 G.T. |
| Ore | No change | | | | |

Basing points and differentials unchanged. Prices effective at once.

## Examination for Mineral Geographers

In an effort to secure several mineral geographers and mineral geographic aids for the U. S. Geological Survey, the Civil Service Commission will hold a competitive examination Apr. 9 and 10. The examination may be taken at the usual places throughout the United States. According to the commission's announcement, the duties of appointees will consist chiefly of the preparation of reports upon the mineral resources of the United States and other countries, including the studies of occurrence, production, consumption, and

movement of mineral commodities in world trade. Appointees will be eligible for promotion to higher grades.

Competitors who pass the examination for appointment to the position of mineral geographic aid will receive salaries ranging from $1200 to $1440 a year; competitors eligible for appointment to the positions of mineral geographer, $2400 a year and higher; associate mineral geographer $1800 to $2340 a year; and assistant mineral geographer $1500 to $1740 a year. At present there is one vacancy in the position of mineral geographer, and there are several vacancies in each of the other positions.

For mineral geographic aid, applicants must have been graduated from a college, university, school of mines, or school of mining engineering of recognized standing, or be senior student in such an institution and furnish proof of actual graduation within three months from the date of the examination. For mineral geographer, in addition to the education above prescribed, applicants must have had at least one year's graduate work in geology or geography, or a year of practical experience in field or office studies relating to mineral deposits.

Statements as to training and experience are accepted subject to verification. Applicants must have reached their 20th but not their 45th birthday on the date of the examination. Applicants must submit to the examiner on the day of the examination their photographs, taken within two years, securely pasted in the space provided on the admission cards sent them after their applications are filed. Proofs or group photographs will not be accepted. The examination is open to all citizens of the United States who are able to meet the requirements.

Applicants should at once apply for Form 1312, stating the title of the examination desired, to the Civil Service Commission, Washington, D. C., or to the secretary of the U. S. Civil Service Board at any place listed thereon. Applications should be properly executed, excluding the medical certificate, and filed with the commission at Washington in time to arrange for the examination at such place as may be selected by the applicant.

## Promotion of Industrial Research

Great Britain's action in setting aside £1,000,000 for the promotion of industrial research is expected to stimulate a movement in the same direction which has been under way for some time in this country. A proposal to that end is contained in a bill introduced in the recent session of Congress by Senator Hoke Smith and Representative William S. Howard. As the Smith-Howard bill contains certain objections, which are regarded as precluding its passage, the National Research Council is endeavoring to perfect a new one.

The salient features of the British plan have been communicated to the U. S. Bureau of Mines. Under it, representatives of an industry who are interested in obtaining the benefits of more extended research make application to the government council for a grant. If the application is approved, certain sums are set aside for specified purposes. There must be also certain proportionate contributions by the industry. The results of the work are to be available to all the companies that contributed to the research fund, but are not to be available to outsiders.

## Business Training for Engineer Students

Convinced that insufficient attention is being given to business training in the engineering courses of the higher institutions of learning, the U. S. Commissioner of Education is conferring with representatives of these institutions. In these conferences, the commissioner is being represented by Dr. G. L. Swiggett, the specialist in charge of commercial education for the Bureau of Education. Dr. Swiggett was secretary in charge of the second Pan-American Scientific Conference, which was held in Washington in 1915.

The matter first was called to the attention of a small group of administrative professors of engineering and commerce from several of the institutions in the Middle West. There was such unanimity of opinion that the average engineer is leaving college with insufficient business training that it was decided to hold a large conference in Washington on Mar. 31. At this conference an effort is to be made to formulate plans as to curricula which it is hoped the various colleges and universities may consider worthy of adoption.

As it is expected that the United States will take a far more active interest in projects in other countries calling for engineering skill, it is the opinion of Dr. Swiggett that the requirements for that purpose alone would justify greater attention to the business side of engineering education.

The conference on Mar. 31 also will be attended by representatives of the four leading national engineering societies and of the Society for the Promotion of Engineering Education. The conference is to be of an executive nature.

## Against Protecting Potash Industry

Representatives in Washington of farmers' organizations are outspoken in their opposition to the Henderson potash bill, which died with the recent Congress. It is Senator Henderson's intention to reintroduce the bill as soon as the extra session is convened. The opposition to it is so strong, however, that it may be difficult to get a bill out of the committee which materially restricts the importation of foreign potash. If such a bill were reported, extended debate and deferment of consideration would ensue. For this reason, a plan is now being considered which would empower the War Trade Board, under certain restrictions, to prevent dumping of potash, dyestuffs, or other materials. This plan involves legislation to continue the life of the War Trade Board, which under present law automatically will cease to exist with the signing of the peace treaty.

Nitrate importers have agreed with the Government to sell the War Department's surplus of sodium nitrate on a basis of one pound of Government nitrate to each two pounds of their own. The disposition will be made by the same importers by whom it was purchased originally. The importers will be allowed to deduct the actual expense incurred in making the sales, but all the nitrate will be disposed of at the market price.

That the quality and extent of the potash deposits in upper Alsace has not been realized outside of Germany is the belief of officials in Washington. Information from German sources has just become available which leads to the conclusion the Alsace deposits are of far greater value than the potash monopoly cared to have known.

## Norcross Commands Twenty-Seventh

Colonel Perry, who received his "eagles" just before leaving France, gave a farewell dinner to his officers at the Columbia Club on Mar. 24. On the following day he relinquished command of the Twenty-seventh, having been ordered to duty with the Chief of Engineers in Washington. Maj. F. S. Norcross succeeded to the command. The regiment is now being dispersed in squads among the camps nearest the several homes, headquarters going to Camp Grant, Illinois.

As announced in the last issue, the Comfort Fund for the mining regiment has reached its goal of $20,000.

## Engineers Propose U. S. Department Of Public Works

The following communication has been sent to engineering organizations in the United States:

ENGINEERING COUNCIL
McLachlen Bldg., Washington, D. C.

March 11, 1919.

On Feb. 20, 1919, Engineering Council passed a resolution advocating the creation by Congress of a Department of Public Works and urging all members of the engineering profession in all branches to participate in an effort to acquaint the people of the country with the critical importance of this matter and to assist in the creation of such a department.

The principle underlying the foregoing has been urged during the last half century by many engineers, but no legislative result has ever been achieved. The need for a Department of Public Works has now become so urgent that the project is being advocated throughout the country. Immediate action by engineers is desirable, so that a well-considered plan, which will receive unanimous engineering support, may be laid before the 66th Congress.

Therefore by virtue of authority vested in me by Engineering Council, I hereby cordially invite each engineering organization to which this call is conveyed to appoint one delegate to meet with the National Service Committee of Engineering Council in joint session at Chicago, Ill., Apr. 23 to 25, for the purpose of taking such action as may be necessary to achieve the desired result.

It is hoped that each organization will act promptly and favorably on this invitation. Kindly send notice of acceptance to M. O. Leighton, Chairman, National Service Committee, Engineering Council, 502 McLachlen Bldg., Washington, D. C., giving the total number of members in your organization at date of notice. Advice concerning local arrangements and provisional program will be forwarded on receipt of acceptance notice.

J. PARKE CHANNING,
Chairman, Engineering Council.

The local arrangements at Chicago will be in charge of the general committee of Technical Societies of Chicago, which is a federation of all the local engineering organizations. The executive committee of the general committee will be in immediate charge, working with C. B. Burdick, member of the American Society of Civil Engineers, who is the Chicago member of the Engineering Council's committee on national service.

Details of the conference are being worked out by the national service committee, of which M. O. Leighton is chairman. This conference is the result of a large amount of agitation that has been going on for some years. It is expected that a resolution will be drafted which can be presented to Congress and which will receive the unanimous support of the engineers of the country.

Although the conference will determine upon some plan to be followed, informal discussions that have taken place among engineers seem to indicate that the plan which is receiving the greatest following will consist of a rearrangement of Federal engineering functions, rather than the creation of an additional Cabinet office.

Under such a rearrangement, the various engineer bureaus of the Government would be brought together under one department, instead of being distributed among several departments, as at present, which would result in a common administration of engineering work, a large saving of expenses to the Government, especially overhead expenses, and an increased efficiency arising from the combining of the several functions under one authority and the prevention of duplication which now occasionally occurs.

The project of organizing a Department of Public Works is not new. Many attempts have been made to induce Congress to enact the necessary legislation. All have failed, for one reason or another. Experience gained in connection with public works since the war started, and the obvious disadvantage of the chaotic system of public-works management, have convinced the engineers that a strong effort must be made to secure the obvious remedies.

Engineers in general do not expect that a successful result will surely follow the first attempt, although every effort will be made toward that end.

## Government Will Sell Rail Stocks

The Government plans to sell at prevailing market prices the surplus stock of 80-lb. rail and 25-lb. rail ordered for the American Expeditionary Force overseas, but not required, owing to the signing of the armistice. There are about 50,000 tons of 80-lb. rail and about 7000 tons of 25-lb. rail; also large quantities of crossings, slip switches, and turn-outs. The bulk of this material is at port, readily accessible for loading. All sales are being conducted through the office of the Director General of Military Railways, Washington, D. C., where further information can be obtained.

## Employment for Engineers

For the convenience of engineers returning from military service, a list of agencies is here given which may be helpful to those who are seeking employment:

Engineering Societies Employment Bureau: Walter V. Brown, secretary, 29 West 39th St., New York City.

Division of Engineering, United States Employment Service: A. H. Krom, director, 29 South La Salle St., Chicago, Ill.

Professional and Special Section, United States Employment Service: George W. Kirchwey, state director, 16 East 42d St., New York City.

## To Encourage Unhampered Research

Speaking at a recent meeting of the Royal Institution in London, Sir J. Dewar said that a few years before the war Professor Haber had paid the institution a visit, with the object of studying the best means of establishing similar bodies in Germany, as there it was felt that many of the research workers were too much dominated by manufacturing and academic influences. Since then five or six Kaiser Wilhelm Institutes had been founded on the model of the Royal Institution. The latter had always been conducted on individualistic lines, being maintained by the members, and at an average cost of not more than $6000 per annum during the first 100 years. The speaker declared that he feared for its security, now that state interference was the order of the day.

## Quebec Asbestos in 1918*

Asbestos mining in Quebec was active during 1918, and asbestos is one of the few substances on which the cessation of hostilities will have no effect for some time. Owing to the program of intensive construction of ships which has been laid out by various countries, the demand for asbestos will continue, as considerable quantities of this substance are used in shipbuilding.

Both the tonnage and the value show marked increase as compared with 1917, although it will be noticed in the accompanying tables that the amount of rock mined is less. The value of the asbestos recovered from the average ton of rock was $4.06 in 1918, $3.08 in 1917, and $2.13 in 1916.

PRODUCTION OF ASBESTOS IN THE PROVINCE OF QUEBEC IN 1918

| Designation of Grade | Shipments and Sales Tons | Shipments and Sales Value | Average Value per Ton | Stock on Hand Dec. 31, 1918 Tons | Stock on Hand Dec. 31, 1918 Value |
|---|---|---|---|---|---|
| Crude No. 1 | 1,808 | $1,695,761 | $937.92 | 1,104 | $985,449 |
| Crude No. 2 | 1,896 | 805,331 | 424.74 | 582 | 122,399 |
| Mill Stock No. 1 | 13,559 | 2,221,954 | 163.87 | 2,993 | 586,850 |
| Mill Stock No. 2 | 32,412 | 1,852,992 | 57.17 | 2,522 | 154,934 |
| Mill Stock No. 3 | 92,700 | 2,443,861 | 26.36 | 7,033 | 234,890 |
| Totals | 142,375 | 9,019,899 | 63.35 | 14,234 | 2,084,522 |
| Asbestic | 16,850 | 34,046 | 2.02 | 375 | 873 |
| Totals | 159,225 | $9,053,945 | ..... | 14,609 | $2,085,395 |

Quantity of rock mined in 1918 was 2,445,745 tons.

PRODUCTION OF ASBESTOS IN THE PROVINCE OF QUEBEC IN 1917

| Designation of Grade | Shipments and Sales Tons | Shipments and Sales Value | Average Value per Ton | Stock on Hand Dec. 31, 1917 Tons | Stock on Hand Dec. 31, 1917 Value |
|---|---|---|---|---|---|
| Crude No. 1 | 1,761 | $1,370,740 | $778.38 | 580 | $470,923 |
| Crude No. 2 | 3,603 | 1,374,387 | 381.46 | 746 | 269,766 |
| Mill Stock No. 1 | 13,197 | 1,318,387 | 99.90 | 1,089 | 206,124 |
| Mill Stock No. 2 | 54,072 | 1,988,197 | 36.77 | 3,346 | 141,344 |
| Mill Stock No. 3 | 64,609 | 1,146,847 | 17.75 | 7,447 | 124,735 |
| Totals | 137,242 | 7,198,558 | 52.45 | 13,208 | 1,212,892 |
| Asbestic | 17,210 | 42,139 | 2.45 | 263 | 805 |
| Totals | 154,452 | $7,240,697 | ..... | 13,471 | $1,213,697 |

Quantity of rock mined in 1917 was 2,634,410 tons.

*Abstract from "Preliminary Statement on the Mineral Production in the Province of Quebec," Quebec Bureau of Mines.

## Get the Worth of Your Money

It would be interesting if one could examine an authentic record of mining investments and compile three lists, one in which the investments had been profitable, a second showing a fair return for money invested, and a third list of investments in which the money had been lost without any compensation whatever. If it were possible to compile such a record it is probable that those in the latter class would foot up to a rather handsome total, particularly among American investors.

One besetting sin of the American people, recognized the world over, is that few of them make any effort to get the worth of their money. "Easy come and easy go" has been their motto for so long that Americans have established an international reputation as "easy marks." The war and the necessity for each citizen to play some part in it have taught many that if purchasing is done thoughtfully and an attempt is made to get the worth of the money expended, it is possible to have a few dollars at the end of the month with which to buy Liberty bonds.

More of these bonds must be taken, but, feeling that the danger point has been passed, many are inclined to relax all patriotic efforts and "let Jones walk the floor."

Perhaps the fighting is over and the death lists are closed, but the bills are not yet paid, and it is incumbent upon those who are still safe and sound to see that they are paid. Let no one stint himself—the necessity for this may have passed—but let all remember the lessons learned on careful buying, and get the worth of the money spent, whether it be in buying socks or stocks, wines or mines. The savings that may easily be made will amply pay each individual's share of the indebtedness that Uncle Sam has incurred on his behalf.

## Proved Oil Territory in California

The proved area of California oil fields, according to the Standard Oil Co., aggregates 99,844 acres, equivalent to 141.94 square miles. In the determination, the lines were drawn 200 to 300 ft. outside of the field and in the instance of outlying single wells the field is credited with about 15 acres, thus representing the actual proved area, giving no consideration to territory generally regarded as proved but not fully drilled. Large areas in Buena Vista Hills, generally regarded as proved, are not included in the accompanying tabulation, which also shows the total production of oil in California to Dec. 31, 1918, and the total barrels per acre in the respective fields.

TOTAL PRODUCTION, AREA, AND PRODUCTION PER ACRE OF CALIFORNIA OIL FIELDS TO DEC. 31, 1918

| Field | Proved Acreage | Total Production to Dec. 31, 1918 (Barrels) | Total Barrels per Acre to Dec. 31, 1918 |
|---|---|---|---|
| Kern River | 7,755 | 206,566,725 | 26,637 |
| McKittrick | 1,645 | 55,165,388 | 33,535 |
| Midway-Sunset | 40,582 | 325,871,087 | 8,030 |
| Lost Hills-Belridge | 4,675 | 33,846,134 | 7,240 |
| Coalinga | 14,916 | 213,155,797 | 14,290 |
| Lompoc and Santa Maria | 7,998 | 88,057,211 | 11,010 |
| Ventura County and Newhall | 4,904 | 21,311,263 | 4,346 |
| Los Angeles and Salt Lake | 2,700 | 54,300,112 | 20,111 |
| Whittier-Fullerton | 5,239 | 140,487,718 | 26,816 |
| Summerland | 230 | 2,234,947 | 9,717 |
| Miscellaneous | (a) 200 | 992,102 | 4,961 |
| Totals | 90,844 | 1,141,988,484 | 12,571 |

(a) Estimated.

## Bismuth in California*

Several bismuth minerals have been found in California, notably native bismuth and bismite (the ocher) in the tourmaline gem district in San Diego and Riverside counties, near Pala. Other occurrences of bismuth minerals, including the sulphide, bismuthinite, have been noted in Inyo, Fresno, Nevada, Tuolumne, and Mono counties, but in small quantities. The only commercial production recorded was 20 tons, valued at $2400, in 1904, and credited to Riverside County.

Recovery of bismuth from blister copper in the electrolytic refinery has been noted[1], ranging as high as 27.3 lb of metallic bismuth per 100 tons of blister copper from the Iron Mountain, Shasta County, ores.

The uses of bismuth are somewhat restricted, the metal being employed principally in the preparation of medicinal salts, and in low melting-point or cliché alloys. These alloys are utilized in automatic fire sprinkler systems, in electrical fuses, and in solders.

**California Mineral Production** in 1918 is estimated by the California State Mining Bureau as follows, it being understood that these are simply preliminary figures, the revised returns to be reported later: Tungsten concentrates, 2300 tons; lead, 7500 tons; zinc, 2250 tons; quicksilver, 22,000 flasks; petroleum, 100,000,000 bbl.; chromite, 52,000 tons; manganese ores, 25,000 tons; magnesite, 90,000 tons. The production of gold, silver and copper is not here stated, as estimates of these for California have already been made.

*Abstracted from *Bull.* 83, "California Mineral Production for 1917," California State Mining Bureau.

[1]*Trans.* A. I. M. E., Vol. 47, pp. 217-218.

# Editorials

## The Return of the Twenty-Seventh

IT WAS the good fortune of representatives of the *Journal* to meet the incoming Twenty-seventh, and we can assure our readers that it was with a feeling of pride that we watched the great transport making its way slowly up the river, and in our mind's eye we visioned the return of the soul of a great industry. It was with confidence that we said good-bye to the mining regiment, with pride that we noted its accomplishments in the great struggle, and now its safe and victorious return is an occasion for thankfulness.

The mining industry deserves much credit for the part it has played in the fight—its response to the nation's call for materials, its contributions to the various funds and Liberty loans, and last, but by no means least, the individual effort of each man of the Twenty-seventh. Previously imbued with a spirit of coöperation, and appreciative of the value of working together, these men have exhibited a characteristic *esprit de corps* throughout their entire experiences "over there" that does them credit, and in the complete history that will be written will be chronicled many instances of bravery, steadfastness of purpose, and accomplishment that have been performed by our own mining regiment —the Twenty-seventh.

Following its organization at Camp Meade in October, 1917, the regiment was speedily filled by men recruited from various mining districts: engineers, artisans, miners, and others, all well equipped to undertake such work as was assigned by their respective commands. Their intensive training at Camp Meade and their previous experiences in practical work combined to make a splendid unit, and, although circumstances were such that they were not required to do actual military mining, their versatility proved of immense value, and the record made by the regiment in road and bridge building and other construction work is an enviable one. But not alone on these accomplishments do their laurels rest, for we know the Twenty-seventh to be fighters as well as builders, and the stories of hand-to-hand conflicts, spirited dashes in the night and all manner of reconnoissance work make up a history that rivals the brave pages to be written of other regiments.

Company A went to France in February, 1918, companies B and C followed in June, and D, E and F went on Sept. 1. They worked at Chateau-Thierry, St. Mihiel and the Argonne, and in the Argonne-Meuse sector alone built 55 bridges, spanning rivers with pontoons and foot-bridges. They return—44 officers and 1349 men, under the command of Col. Oscar B. Perry—with three regimental citations and the names of three great battles on their flag. During its service the regiment lost only six men, and 31 were wounded. This, in short, is the history of the Twenty-seventh—certainly an enviable record and one in which every man connected with the mining industry should have pride.

We are advised from many sections that the welcome home is to be a warm one. Realizing the sacrifices the men have made, it will indeed be most appropriate for the mining industry fittingly to express its appreciation of a service well rendered and successfully completed. The training and experiences have been such that the Twenty-seventh returns a bigger and keener industrial army, and the men will be anxious to again assume the responsibilities which they left. In districts where curtailment of mine operations has followed a lack of demand for the product mined, and in which high costs have made mining unprofitable, it has been necessary to reduce forces to some extent. But, with the return to normal conditions, the mining industry enters an era of prosperity that promises to be permanent. The situation demands the employment of big men; men whose opportunities well fit them to cope with the growing problems of operation. Of such are the Twenty-seventh.

## Position of the Low-Grade Zinc Mines

THE need for efficient operation is felt at this time more acutely than at any other of which there is record. Bed-rock prices for zinc, increasing labor and supply cost, and a marked decrease in labor efficiency combine to make the position of the operator of a zinc mine in Wisconsin a far from comfortable one. Like conditions maintain in other kinds of metal mining also, and in other localities as well. W. F. Boericke, in another place in this issue, shows how the mining of zinc ores in Wisconsin has increased on a unit basis to 55.1% over the costs in 1914. To overcome this heavy increase there is the remote possibility of the decrease of wages and supply cost. Both of these may eventually take place, but the operator who desires to continue mining is almost compelled to look in other directions for a solution of the problem.

Mr. Boericke points out various ways of successfully increasing efficiency and promoting economy. He, however, states that the operators have been obliged to resort to the mining of richer ground, and, where this has been impossible, the usual policy is to close the mine rather than exhaust the ore reserves on an unprofitable market. It is a pleasure to note that the attitude of the miners and mill men has been generally good. Wholehearted coöperation on their part will lighten many an operator's difficulties, and make it possible to continue the operation of mines that are on the ragged edge.

## About Spanish

LATE in January a facetious correspondent favored us with his opinions as to the advisability of promoting the study of Spanish in the United States. His letter, which we published, was written in lighter vein; and although not intended to be taken seriously *in toto*, it contained, nevertheless, a number of conclusions which could be considered logical and which might prove difficult to controvert. His main object was to emphasize the logic in the contention that the study of a particular foreign language at school or college is,

more or less, an unprofitable investment. He cited an instance where a large class of students took Spanish, all of whom had no working knowledge of the language when they subsequently needed it in a Latin-American country.

The majority will admit that there is a lamentable waste of time learning languages that are subsequently forgotten. Knowledge so gained must be continually exercised and added to by daily practice. This is the prime factor to insure fluency. We are inclined to agree with our correspondent that the student who laboriously acquires a classroom knowledge of Spanish in an American town or city will probably find that he could have spent his time to better advantage. Of course, it depends largely on the man. An intelligent person can learn enough Spanish in a few weeks to make himself understood, and is then able to absorb local or technical phraseology with facility, and so expand his vocabulary to the desired degree.

In this issue we print a further contribution by another correspondent, in South America, who takes a view which on primary consideration appears to be diametrically opposite to that of our earlier contributor; but, on second thought, we are inclined to believe that both opinions may be right. There is nothing like a positive statement for eliciting facts. No amount of lukewarm theorizing ever achieved anything; and between the two somewhat extreme views presented we would endeavor to steer a middle course.

The fact is not sufficiently realized that a really workable knowledge of Spanish, including an ability to speak, read, and write the language in accordance with the niceties that local custom dictates in, say, Uruguay, Chile, Spain, and Mexico, might be considered impracticable because of the intensive study that would be needed for a considerable length of time. The idiomatic expression of a language in a particular country or district can be best left to natives; and, as our earlier correspondent pointed out, men to do clerical work of this kind can be hired for a nominal sum.

We appreciate the fact that an acquaintance with Spanish will undoubtedly be useful to an engineer going to one of the Spanish-speaking Latin-American countries; but, when it comes to the question of *habla*, we suspect that prospective employees' qualifications in this connection would be more favorably viewed if the language had been acquired in the field rather than in the classroom. The attainment of the necessary perfection in the latter case means a strenuous effort, and a considerable expenditure of time, if not money. A new language can best be studied after one reaches the country where it is spoken, and not before. It is then that ample opportunity occurs to concentrate on the imperative and the necessary, to the exclusion of the unessential; and it is only by practice that even a fair degree of perfection can be attained.

Languages to many men are anathema—they even multilate their own mother tongue in speech and script. Of them little can be said other than that the condition is often due to the neglect of fundamentals at school or college. Others—and an engineer to be worthy of the name should be in this category—attempt the acquiring of a language only when the labor is justified, and usually realize that the result will be achieved with the minimum of exertion and without waste of time by personal contact with natives speaking the language.

American mining companies in Chile and Peru doubtless like to engage men with a knowledge of Spanish, but they would probably prefer those who have acquired it in the field. Next to this class might be grouped the men with no knowledge of Spanish, or time to spare from professional work to study it from a "professor," but with more than enough initiative, energy, and intelligence to pick up a rudimentary knowledge of the new tongue on the voyage down, and sufficient interest in the prospect of advancement to make themselves proficient when they get there.

In the final category comes the man who has, perhaps, spent years studying Spanish at school, absorbing Castilian niceties of phraseology and mood, which are of no use to him in the field, even if he remembers them—which he probably does not. The whole problem must be faced boldly, and care taken that fundamental factors are not ignored. Let us avoid the pitiable error of insisting on the acquisition of Spanish by school children, to the detriment of their knowledge of and their ability to express themselves in English.

The root of success in connection with the acquisition of a new language, as in other branches of endeavor, is a determination to succeed; and the cheapest method of acquiring Spanish is to learn it from the natives of the new country where profession or trade takes one, recognizing the potentialities and intrinsic worth of that courtesy and civility which are the characteristic traits of our Southern neighbors.

## The Licensing of Hoisting Engineers

IT SEEMS almost unnecessary to advocate the licensing of hoisting engineers, as is done in a late report by the Inspector of Mines of Nevada. Nevada may well draw from the experience of other mining states in this respect. To leave the selection of hoisting engineers entirely to operators is, in our opinion, inadvisable. Undoubtedly the majority of operators discriminate carefully in choosing men for this important service, but there is danger that inexperienced and unfit men may be selected in some instances. Requiring all hoisting engineers to take out licenses, either on the basis of considerable experience or on a rigorous examination, is strongly advisable; and mining codes that contain no provision for such licenses should be amended.

## The Adjustment of Prices

THE resumption and the maintenance of industry in the largest practicable volume are much to be desired. Conditions are now such that industry unaided is likely to take a long time reasonably to approach anywhere near normality.

Some diseases require prompt surgical treatment. In the case of others nature may be allowed to take her course; but in almost all instances care and attention are factors that hasten recovery and complete a permanent cure. Rigorous surgical treatment has been accorded war contracts and many war activities that have formed temporarily a part of the industrial body. Many may question whether the treatment has not been too drastic. However that may be, the fact remains that industry as a whole is greatly in need of most careful handling. Experienced and broad-minded leaders are necessary to bring industry back to a healthy condition. Stabilization of industrial factors is essential to restore confidence.

The Industrial Board of the Department of Commerce

has accomplished a beginning by the agreement that has been reached with the steel manufacturers. A cut has been made of fully 20% below war prices, and from 10 to 14% under post-war prices, in the basic steel commodities. The price of iron ore is to remain the same as it is at present until the projected reduction in freight rates that affect this commodity takes place. Steel prices are to be maintained for a year. This is contrary to precedent in the steel industry, where formerly prices have been revised quarterly.

The price of copper has dropped 42%, lead 35%, and zinc 24% from quotations that prevailed in November last. Compared with these reductions, which are based on a free market and sound economic practice, the cut of 20% from war prices in the case of steel is not sufficient. Greater sacrifices must be made, and the sooner they are made the sooner will industrial activity be resumed.

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The careless adjustment, or in some cases the entire absence of adjustment, of steam engines provided with adjustable valve gear, results in waste that closely approaches "paying through the nose." The mechanical equipment of a mine should be examined at regular intervals for lack of adjustment, faulty bearings, imperfect lubrication and improper alignment. A good mechanical department and a system of monthly reports of the mechanical condition of equipment will pay for itself. S. A. Worcester, in his excellent paper on "Steam Economics in Simple Terms," draws attention to an insidious kind of waste that results partly from lack of knowledge and partly from carelessness. Such wastes are inexcusable at any time, but particularly at present, when continuation of operation in some instances is dependent upon rigid economy in every department.

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In this issue we reproduce four photographs under the title "Mining Asbestos in Quebec," which show operations in the Thetford-Black Lake-East Broughton district. We also publish an abstract of a report, "Quebec Asbestos in 1918," by the Quebec Bureau of Mines, which shows that the industry enjoyed continuous and active operation during the last year. There is reason to believe that the demand for asbestos of the various grades will continue. It is our intention to reproduce in later issues of the *Journal* other photographs showing the Quebec asbestos operations, which we have received through the courtesy of the Asbestos and Mineral Corporation, Whitehall Bldg., New York.

## BY THE WAY

Dr. A. B. McCallum, chairman of the Canadian Advisory Council for Scientific and Industrial Research, in the course of an address to the Canadian Mining Institute, made frequent use of the word "researcher," as a synonym, or substitute, for the term investigator. He stated that he had been criticized for doing so, but that it was etymologically correct and a needed addition to the language. "When you speak of an investigator," he said, "people immediately think of the probing of some unsavory political scandal." Apart from this objection, "researcher" seems to characterize the work undertaken under the auspices of the council better than "investigator."

The difficulties in obtaining a fair verdict in Washoe lawsuits, in a district where every one speculated in mining claims, are narrated by Eliot Lord in Monograph 4, U. S. Geological Survey. The bias in many instances was intentionally increased by direct bribing. A discreet observer wrote with simple irony to the *Territorial Enterprise* in 1865 to inquire "Whether the following transactions would disqualify a gentleman from serving as a juror in the future: 1. Throwing out of the court-house window a paper on which was written 'See me with $1000; I will then tell you tomorrow morning how the thing will go, and we can make money.' 2. Taking the wrapper from a cigar and having replaced it with a note on which my terms were written, leaving the enclosed cigar where my friend could get it. 3. Finding a note under the lining of my hat offering me '$5000 provided you go for us,' but giving my verdict only to be fooled by the company." The inquirer fortified his assumed position by quoting from Johnson's Life of Addison the saying: "It is not necessary to refuse benefit from a bad man when the acceptance implies no approbation of the crime."

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Cap'n Dick was seriously regarding the sheave in the headframe as it turned, slowly at first, and then increased to a high speed and gradually slowed down as the skip came into view and finally emptied into the pocket. "M'son," said he, "didst thee ever realize tha turibble strainin' an' twistin' that one o' them there h'axles mus' stan'? Wonnerful, m'son, wonnerful! I never did tell thee tha story baout 'ow I figgered tha worl' 'ad come to a h'end, did I? Well, I'll 'ave to tell 'e. Years h'ago, back long we, schoolmaster 'e'd tell us baout these 'ere w'irlin's o' tha universe, an' 'ow tha h'earth wuz suspended a'tween two gert poles, an' gawin' raoun' an' raoun' tha 'ol bloody time. An', min' you, this 'ere h'impressed me; 'ardlike, I might say. H'any'ow, years followin', I wuz shif'boss to 'Arris mine, an' one day I wuz takin' five, 'avin' a bit o' Peerless an' wonderin' 'ow tha stope we figgered to blas' that night, w'en shif' went off, would come daown. Of a sudden, 'ere come two chaps runnin', an', dam-me, I wonnered w'ot wuz h'up. An', min' you, m'son, clean scared they wuz. Come from stope h'above, w'ere rock wuz 'ard an' needed naw timberin'; a gert h'open cavity, m'son. Never a bloody word could they say h'as to w'ot 'ad 'appened, but, h'any'ow, back we gaws to see w'ot's h'up. An', believe me or no, m'son, w'en we reached that stope 'ere wuz a noise an' commotion like tha 'osts o' 'ell, an' in tha middle o' tha stope wuz a gert revolvin' pole, w'irlin' raound like a bein' possessed, an' swingin' from side to side. Dam-me, m'son, I never naws w'ot to make on un, an' 'ere wuz they two chaps tremblin' from 'ead to foot, an' cryin' h'out that tha wrath o' tha h'Almighty wuz decendin' h'upon them. 'Baout tha h'only thing I could figger wuz tha 'ol bloody worl' 'ad slipped h'off these 'ere poles. Then, o' a sudden tha bloody beggar stopped, an' h'up I gaws, although min' you, m'son, it did take a 'eap o' courage to do un. An' w'ot dost thee think t'were, m'son? Nothin' but one o' these 'ere diamond drills that we 'ad put daown from surface, an' dam-me, she wouldn't stay w'ere she wuz to. Jus' started h'off followin' some bloody seam or h'other, an' h'out she come in this 'ere stope. But, min' you, m'son, 'appenin's like they do tax tha 'eart tremendus."

## Personals

**George C. Stone** will investigate conditions affecting the zinc industry in Europe.

**Fred W. Denton** is vice-president of the Copper Range Co., 82 Devonshire St., Boston, Mass.

**Alvin B. Carpenter** has been elected a director of the Chamber of Mines and Oil of Los Angeles.

**Rudolf Gahl** has moved his office from 1213 First National Bank Bldg., to 804 Equitable Bldg., Denver, Colorado.

**W. A. McGonagle**, president of the Duluth, Misabe & Northern R. R., is in California convalescing from influenza.

**M. F. Chase** is in France to investigate the condition of the zinc metallurgical industry, particularly in regard to acid plants.

**Lieut. Ralph Edmundson, Lieutenant Douglas Chapin,** and **Lieutenant Howard King** returned with the 27th Engineers.

**Mark Workman,** president of the Dominion Steel Corporation, who has been in England for some weeks, has sailed for Canada.

**Ralph Budd**, vice-president of the Great Northern R.R., has been named trustee of the Great Northern Ore properties, succeeding **Walter J. Hill,** who resigned some time ago.

**C. James Smith,** mining engineer and geologist, has succeeded to the business of C. E. Anthony, assayer and chemist, 218 West F St., San Diego, Calif. Mr. Anthony died recently.

**Harold E. Taylor** will assume a position with the Aluminum Castings Co., Cleveland, in the metallurgical department, where he will classify the results of experiments made by the company.

**C. A. Myers** has resigned his position as superintendent of the Plymouth mine on the Gogebic Range, and on Apr. 1 will become manager of the Coates & Tweed properties on the Mesabi Range.

**Lieut. Wilder Laby, Lieutenant C. J. Mampel** and **Lieutenant Joseph R. Gulteras** returned with the 27th Engineers, having spent about eight months in France, engaged in bridge construction.

**Capt. Edwin S. Berry** was detached from the 27th Engineers to serve on a Peace Conference committee to determine the damage done to the coal and iron mines of Northern France and Belgium.

**H. H. Morgan,** formerly with the Chicago office of Robert W. Hunt & Co., for many years in charge of the physical laboratory, has been made assistant to D. W. McNaugher in the Pittsburgh office.

**Donald C. Smith** has resigned his position as metallurgist with the Penn. Mining Co. at Campo Seco, Calif., and has accepted a similar one with the Afterthought Copper Co. at Ingot, Shasta County, California.

**Maj. F. S. Norcross,** of Michigan, who was in command of the First Battalion, and **Maj. R. E. Franklin,** of California, who was in command of the Second Battalion, accompanied the 27th Engineers on their return.

**Capt. Ward Royce,** of the 27th Engineers, Co. B, with a detail of miners, was cited for bravery while building a highway bridge at Apremont. The work was completed in four days under fire of German sharpshooters.

**H. H. Johnson**, consulting engineer of the Kirkland Lake Proprietary, Ltd., an English company, is at Kirkland Lake in connection with the proposed consolidation of the Tough Oakes, Burnside, and Sylvanite properties.

**F. M. Sylvester,** managing director of the Granby Consolidated Mining and Smelting Co., has left on a business trip to New York. It is understood that no announcement will be made concerning resumption of work at Anyox smeltery until his return.

**Col. Oscar B. Perry,** who organized and commanded the famous 27th Engineers, which was cited three times for its work under fire, arrived from France on board the "Dakotan" on Mar. 20. Colonel Perry will reside at the Waldorf-Astoria, New York.

**W. F. Slaughter**, for many years chief mining engineer for the eastern Mesabi operations of Pickands, Mather & Co., has been appointed superintendent of that company's Rowe mine on the Cuyuna range and is now preparing the property for an active season.

**Lieut. Robert Burrage,** of the 27th Engineers, which arrived in New York on Mar. 20, was cited for reconnoissance work at Bilosnes on Nov. 1, when he entered the German trenches with a patrol and killed three of the enemy, having only one of his men wounded.

**Lieutenant White,** of the 27th Engineers, Co. A, returned to New York with his regiment. While in command of a detail of mining engineers, on Sept. 29, engaged in construction work in an advanced position, his men met a detachment of Germans, and in the fighting which ensued completely routed the enemy, losing one killed and two wounded.

**C. F. Kelley,** president of the Anaconda Copper Mining Co.; **J. C. Clendennin,** vice-president of the A. S. & R. Co.; **Walter Douglas,** president of the Phelps Dodge Corporation, and **R. L. Agassiz,** president of the Calumet & Hecla Mining Co., who have spent the last two months in Europe for the Copper Export Association, will soon return to New York on the "Aquitania," of the Cunard line.

## Obituary

**A. M. Elliot** died in Denver on Mar. 14 of pneumonia. He had been engaged in mining in Victor and Central City for the last 15 years. He is survived by his widow.

**S. B. Patterson,** prominently identified with iron mining and smelting for many years, died recently in Philadelphia. He was formerly superintendent of the Andover Iron Co.'s furnace and mines at Andover, N. J., and afterward the manager of the Empire Steel and Iron Co. mining and furnace properties. For 12 years, prior to his retirement in 1916, Mr. Patterson was superintendent of the Robesonia Iron Co., Ltd., blast furnace at Robesonia, Penn. He was also engaged at various times in the manufacture of coke in West Virginia and charcoal iron in Michigan.

## Societies

**Society of Chemical Industry,** New York Section, held a meeting on Mar. 21 at Rumford Hall, 50 East 41st Street.

**American Society of Civil Engineers** held a meeting on Mar. 19 in the Engineering Societies Bldg., when E. A. Byrne, chief engineer of the Department of Plant and Structures of New York City, and consulting engineer for the New York and New Jersey Tunnel Commission, discussed the proposed New York and New Jersey vehicular tunnel.

**National Association of Corporation Schools,** Irving Place at 15th St., New York, will stage an interesting exhibit for the benefit of employers and others interested in personnel work, to be shown on the third floor of the Engineering Societies Bldg., 29 West 39th St., on Apr. 1 to 12. The exhibit consists of a collection of wall charts, forms, photographs, and models showing how the Army finds out what men can do best and how it uses that information; how soldiers are trade-tested, and how officers are rated and fitted into place; the manner in which the work is checked and supervised, and its results in the war. The collection is being shown under the auspices of the National Association of Corporation Schools and the United Engineering Society, representing the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers. It was on exhibition for several weeks at Washington, where it excited so much interest that, in response to many requests, the Adjutant General consented to its display in other cities. Two commissioned officers accompany the exhibit to explain its various features.

## Industrial News

**United States Chamber of Commerce** will hold a convention in St. Louis on Apr. 28, 29, and 30. No definite program has been issued up to this time.

**Capt. J. Neale,** Civil Engineer-in-Chief's Department, Room 1004, Admiralty, London, S. W. 1, requests that all advertisers of the "Journal" forward to him at the above address copies of their latest catalogs for purposes of reference.

**American Blower Co.,** Detroit, announces that F. R. Still, vice-president and secretary, has left on an extended trip for the Far East, where he will investigate trade conditions in connection with export work. Mr. Still's itinerary includes Japan, China, Australia, and most of the European countries, and he expects to cover approximately 36,000 miles before returning home about Nov. 1st.

**Lea-Courtenay Co.,** manufacturers of high-duty turbine pumping machinery, Newark, N. J., appointed A. C. Nell the Chicago district manager, with offices at 1466 Conway Bldg. He has been until recently a captain in the construction division, U. S. A., having charge of power and mechanical equipment, and was formerly connected with the Allis-Chalmers Manufacturing Co. Mr. Nell will also represent the Schutte & Koerting Company.

**Westinghouse Electric and Manufacturing Co.,** of Pittsburgh, announces the awarding of a large contract to the Canadian branch by the Hydro-Electric Power Commission of Ontario for two 45,000 kva. vertical water-wheel generators of 12,000 volts, 3-phase, 25-cycles, for the Queenstown development. These will be the largest water-wheel generators ever constructed, and indicate that the commission has decided there is no time like the present for construction work.

**National Foreign Trade Council** will hold the sixth annual convention in Chicago on Apr. 24 to 26, at the Congress Hotel, where registration will take place. A registration fee of $10 will be required of each delegate, the proceeds to be used to defray in part the printing of the official proceedings in a bound volume, which will be sent to each delegate. A directory will be issued promptly, containing a list of the registered delegates and their business affiliations. The theme of the convention will be "Foreign Trade Essential to American Industry." James A. Farrell, chairman of the council and president of the U. S. Steel Corporation, will call the convention to order at 10 a.m. on Apr. 24 in Orchestra Hall. The topic of the session will be "America's Need of Foreign Trade" from the viewpoint of (1) Production; (2) Finance; (3) Labor; (4) Imports. The topics at other sessions will be as follows: "The American Merchant Marine," in which will be discussed American shipbuilding, provision of cargoes, establishment of trade routes and return cargoes and American maritime policy; "Foreign Credits"; "Direct Selling"; "Ocean Service"; "Financing Foreign Trade," and numerous other subjects. The Bureau for Foreign and Domestic Commerce, the Pan-American Union and the Consular Service of the State Department will be represented.

## New Patents

United States patent specifications listed below may be obtained from the "Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

**Aluminum.** Purifying Aluminous material. Charles H. MacDowell and Paul R. Hershman, Chicago, Ill., assignors to Mineral Products Corporation, New York, N. Y. (U. S. No. 1,291,979, Jan. 21, 1919).

**Briqueting Machine.** Warren D. Alexander, Los Angeles, Calif. (U. S. No. 1,291,705; Jan. 21, 1919.)

**Classifier.** Alfred L. Blomfield, Denver, Colo., assignor to the Dorr Co. (U. S. No. 1,292,237; Jan. 21, 1919.)

**Manganese Steel,** Method of Recovering. Wesley G. Nichols, Chicago Heights, Ill., assignor to American Manganese Steel Company, Chicago, Ill. (U. S. No. 1,291,656, Jan. 14, 1919.)

**Metal Scrap,** Treatment of. Edgar Rouse Sutcliffe, Leigh, England. (U. S. No. 1,291,672, Jan. 14, 1919.)

**Melting Points,** Method of Determining. Lewis W. Schubb, Edgewood Park, and Robson De S. Brown, Wilkinsburg, Penn., assignors to Westinghouse Electric and Manufacturing Co. (U. S. No. 1,291,409, Jan. 14, 1919.)

**Nickel-Copper Matte,** Process of Refining. Carl Langer and Otto Langer, Clydach, Wales. (U. S. No. 1,291,030, Jan. 14, 1919.)

**Ore-Concentrating Table.** Edward J. O'Connell, Fort Wayne, Ind., assignor to Deister Concentrator Company. (U. S. No. 1,291,616, Jan. 14, 1919.)

**Storage-Battery Locomotive.** Raymond Mancha, St. Louis, Mo., assignor to Mancha Storage Battery Locomotive Company, St. Louis, Mo. (U. S. No. 1,291,581, Jan. 14, 1919.)

# Editorial Correspondence

### BOSTON, MASS.—Mar. 21

**An Injunction Against Iron Cap Copper Co.** has been issued by Judge Braley, of the Massachusetts Supreme Court, restraining the company from paying a dividend or otherwise disposing of its assets until settlement of the litigation between it and Arizona Commercial Mining Co. A preliminary hearing of the two suits brought by the latter company against Iron Cap was held before Judge Braley, who also ordered that briefs of both parties be submitted to the full bench sitting in May, when the question of jurisdiction will be considered. Iron Cap was also ordered by the court to disclose the nature and value of its assets, such information, however, to be available to the plaintiff only, and not to be written into the record.

### MORENCI, ARIZ.—Mar. 20

**The Arizona Copper Co.'s Mines** were placed on a basis of five days per week on Mar. 1, and wages in the district were put on an 18c. scale with a "high cost of living bonus" of $1 per day for underground men and 75c. per day for surface men. The Longfellow mine has been closed, the men being distributed among the other mines of the company in Morenci. The sensible manner in which the workmen of the Clifton-Morenci district have accepted the recent reduction in wages and working time is thought to augur well for the future of the labor situation in the district.

### WALLACE, IDAHO—Mar. 20

**The Reduction of Wages** by the mining companies of the Coeur d'Alene district became effective on Mar. 16 and was accomplished without notable incident. Employees had generally expected the cut and appreciated the fact that Coeur d'Alene operators had retained the war rate long after reduction had been made in many other districts, and that it was a question of taking half a loaf or no bread. The notices posted at the various mines plainly stated that unless the reduction was accepted the mines would be forced to close. The mining companies had continued to run under the adverse conditions, hoping that there would be a substantial reduction in the cost of living which would lighten the burden imposed upon their employees by the cut. It was, therefore, a matter of regret that the reduction had to be made without this relief. A considerable number of men quit at all the mines, but not all of them on account of the cut in wages. The approach of spring is always a signal for miners to seek other districts, some to go prospecting and others simply yielding to the tendency that is characteristic of the craft to drift from one mining camp to another. All acted individually, and so far as can be learned there was no attempt to induce others to quit, and no picketing about the mines. Some of the companies were perfectly willing to have their forces reduced to the extent of those who drew their time, and those which desired to replace the employees who left had no difficulty in getting men. There was a total absence of agitation, and if there are those in the district who are inclined to make trouble, they are keeping in the background and carefully conceal their purposes. Most of those who quit on account of the cut went to Butte, where wages are 50c. more per day than in the Coeur d'Alene district.

### DULUTH, MINN.—Mar. 20

**The Minnesota Geological Survey**, of which William H. Emmons is director, in conjunction with the U. S. Geological Survey, has issued from the University of Minnesota, Bulletin No. 15, entitled "Preliminary Report on the Geology of East Central Minnesota, Including the Cuyuna Range." The bulletin is of 178 pages, and contains many suitable illustrations and maps.

**The Minnesota Compensation Law** is receiving considerable attention at the hands of the present Legislature, and, under the terms of legislation now pending will be amended almost beyond recognition. In its present form the law calls for a maximum payment of $12 a week over a period of 300 weeks for a fatal accident, with minor injuries graded accordingly, and the settlement of all claims in the hands of the district judges. In its amended form, if passed, the law will demand a maximum of $15 per week for 300 weeks in cases of fatal accident, and the district judges will be displaced by a board of control appointed by the Governor and consisting of one labor representative, one employers' representative, and a third member whose status shall be at the discretion of the Governor. A state insurance bill is also under consideration and is being powerfully supported. It provides that all employers who come under the terms of the compensation act shall prove to the satisfaction of the state authorities that they are capable of carrying any possible loss, failing which they will be forced to take out a policy with the state. The bill is designed to entirely destroy the business of the liability-insurance companies now operating in the state and is being strenuously fought by them for this reason.

### PLATTEVILLE, WIS.—Mar. 20

**The Net Shipment of Zinc Ore** from the Wisconsin district during 1919 to date is 18% short of 1918 figures. The present rate of decline is considerably higher and is growing weekly under the demoralizing effect of high costs and low market for ore. At Highland, the Mineral Point Zinc Co. is shipping crude zinc carbonate, without milling, taken from the old mine shafts on the old-time Kennedy, Minter, and Wallace tracts, which have witnessed continuous mining for lead, zinc carbonate, and blende for the last 70 years. The Lampe-Highland property of the Saxe Brothers is the only other producer with mill equipment active. At Linden the last producer operating with mill was forced to close when the small plant of the Stoner Brothers was destroyed by fire six weeks ago.

Dodgeville, Potosi, and Mineral Point camps are inactive. At Shullsburg, the Oliver Iron Mining Co. is working a full crew at the Mulcahy mine, mill, and roaster; this company has proved up an orebody on the Johnnie Lyons lease. The Wisconsin Zinc Co. has temporarily closed the Copeland mine, a new producer. The Vinegar Hill has a few men at work on its Copeland lease, but is withholding the opening up of this prospect. The Rodham is producing as usual, sending its low-grade blende to the National roaster at Cuba City and carrying in bin a year's accumulation of higher-grade blende.

At the Mifflin-Livingston camp, the Coker, 40 years old, is the only mine working full force. This property of the Mineral Point Zinc Co., with double mill equipment, led the district in 1916 and 1915, with shipment records of 15,106 and 14,031 tons, respectively, of blende concentrates. The Vinegar Hill Zinc Co. has the new Dale Rundell mine equipped and opened, and ready to operate as soon as a better market is evidenced. Other properties recently closed are the Yewdall mine, of the Vinegar Hill Co., and the M. & A., an independent producer.

The Blockhouse is Platteville's only active producer. This mine is now worked to within 200 ft. of the Cruson workings, which mine was abandoned 10 years ago as a "rich pocket," largely because it was erroneously judged to be a "north-and-south" run. The mine has since been driven over a half-mile in length, widening out at times to 230 ft. and making 10 to 20 ft. high, carrying heavy sheet formation and doubling back on its course in S-shape curves, but maintaining a general east-west direction. The property is now averaging 40 tons of 40% blende concentrates daily, with 2500 tons in bins.

Cuba City has one consistent producer in the Connecting Link; the company operating this mine is moving the Gilman mill to the Coulthard-White lease. The Little Dick was opened and equipped with mill last fall by the Zinc Hill Mining Co., but operation has been deferred. This company is just completing the erection of the Cleveland mill on the Harvey lease north of the Connecting Link, where a new shaft is being sunk, the new property to be known as the Big Dick. The Platteville-Dall Co. is prospecting east of the old Dall. The National Zinc ore-separating plant is operating at full capacity. The big Government-built acid plant, contiguous to the National roaster, the construction of which was discontinued in November when 80% completed, is still idle.

At Benton-New Diggings, the Wisconsin Zinc Co. is operating the Champion, Longhorn, and C. A. T. mines and the Skinner roaster at full capacity. The Champion, which was the second largest single mill producer in 1918, led the district in 1917, with 15,727 tons of blende concentrates. The Government-built acid plant, 50% completed, situated alongside of the Skinner roaster, is also idle. The Mineral Point Zinc Co.'s new Hoskins mine is turning out blende concentrates at the rate of 1600 tons per month. From the time it began shipments early in 1918 to the close of the year, 15,771 tons of blende was delivered to Mineral Point. This company's Penna-Benton mine is working a new run of ore developed during the last year. The Meloy and Martin mines of the Vinegar Hill Zinc Co., the Calvert and Middle mines, of the Frontier Co., and the Indian Mound mine, of the Lawrence Mines Co., are operating as usual. The Frontier company is prospecting at the Bull Moose and Bearcat and is carrying a big reserve stock of concentrates at the Bull Moose and Middie properties.

At Hazel Green, the Kennedy, Jefferson, and Monmouth mines are operating. At Galena, the Graham, North Unity, and Black Jack are running as usual. The Blewett is a new producer, equipped with the Burr mill. The history of the Black Jack mine dates back to 1854; the property has passed through the hands of many owners, among them the Illinois Zinc Co. and the Peru Zinc Co. The Kennedy mine, also a property of the Mineral Point Zinc Co., has been in continuous operation for the last 20 years and led the district in production in the years 1909, 1910, 1911 and several years prior thereto.

### THETFORD, QUE.—Mar. 20

**Labor Shortage in the Asbestos Industry** no longer exists. Returned soldiers and excess labor from industries affected by the return to peace conditions afford a surplus of labor, though enforced idleness is not yet apparent. Wages still remain at the high level, and employers are keeping to their avowed intention to hold them up as long as the selling prices of asbestos will permit them to do so. Shipments are still going forward freely, though there is a marked decline from pre-armistice records. Optimism is still the keynote in the industry, and the various companies are planning additions and improvements. The Asbestos Corporation of Canada is increasing its ore-storage facilities by building a 20,000-ton storage bin at its B. C. Mines, at Black Lake. The Bell Asbestos Mines have installed an elaborate system to overcome the dust nuisance, and the Jacobs Asbestos Co. is extending and completing its milling system of underground mining. At East Broughton, where production is entirely a fiber proposition, improvements are being planned to double the output at least. Messrs. Poulin and Roy are erecting a fiber mill adjacent to the Fraser mine of the Asbestos Corporation. The Garcin interests, which are operating the Eastern Townships property, suspended operations for the winter and are employed in remodelling their fiber mill on up-to-date designs. H. H. Williams is in charge of the reconstruction. At the Quebec Asbestos Co., under the management of E. E. Spafford, extensive development has been accomplished with a view to putting the mining end on a basis for steam-shovel operation through a more extensive crushing system and improved conveyor facilities. A 200-ft. vertical shaft is now being sunk on the foot-wall side of the asbestos lode, with the intention of opening up the orebody at depth and affording added ore reserves for increased production. In view of the improved labor situation and increased facilities, it is possible that production of asbestos in 1919 may exceed that of 1918 by 30 per cent.

# The Mining News

## ARIZONA

### Cochise County

DENN-ARIZONA (Bisbee) — Since resuming work in 1917, shaft sunk to 1800 level, and is now bottomed temporarily in sump 1830 ft. from surface. For entire distance from 1100 level sinking has been in leached vein matter, occasionally showing bunches of commercial copper ore, in form of carbonates and oxides. Crosscutting done at various levels; on 1600 level width of this leached ore-bearing material is 315 ft.; on other levels similar condition to that on 1600 is shown for distance driven. On 1600, a promising body of oxidized ore was cut 90 ft. from station, which it is expected, will be cut again on 1700 when drift reaches proper point. Station now being opened on that level, and will soon be started on 1800. Denn extends 4500 ft. along Dividend fault, and leached material that has been opened from 1100 to 1830 ft. is supposed to lie along fault for entire length of contact. Such a body of leached material under 1100 ft. of conglomerate considered unusual. Since resuming work Denn has spent over $1,000,000 in development.

HELEN DOME (Bowie)—New machinery being installed. Ore carries gold and silver and about 2% copper.

GREAT WESTERN (Courtland)—W. J. Young, principal owner, overseeing sinking of new shaft and other development. Power house being equipped with newer types of machinery. Electric power to be used throughout. Shipments of relatively high-grade copper ore being made to Douglas.

LEADVILLE (Gleeson)—Two carloads of ore a day to be shipped to Douglas. Property in charge of owner, William Holmes.

SHANNON (Gleeson)—Recently shut down Copper Belle property, dropping 60 miners.

### Gila County

IRON CAP (Globe)—Plans made for 600-ton mill to handle large quantity of milling ore developed in stoping shipping grade.

SUPERIOR & BOSTON (Globe)—E. G. Deane, Mayor of Miami, made superintendent, succeeding A. L. Graham.

SULPHIDE COPPER (Miami)—Purchased 14 claims in Pinal Mountains, at head of Russell Gulch, from Mrs. Clara Kinney, of Globe.

VAN DYKE (Miami)—Sinking deep shaft to orebody developed by drilling and assumed to be extension of Miami company's deposit.

### Mohave County

HACKBERRY (Hackberry)—New mill ready for operation. Bins filled with good ore from 600 level; body proved down to 800 feet.

RURAL (Mineral Park)—Taken over by M. B Dudley and others, of New York. New hoist and pumps already in place.

GOLD DUST (Oatman)—Working two shifts. New equipment added for deeper development.

GOLD ORE (Oatman)—A. C. Werden, manager, states that company's troubles have been adjusted and that deeper development will be started from 700 level.

RECORD LODE (Oatman)—Crosscut on 500 level has passed through 20 ft. of vein matter.

### Pima County

BEACH (Tucson)—Property in Baboquivari district to have new mill. Excavation started. Plant to be installed by James M. Douglas.

### Santa Cruz County

EXPOSED REEF (Patagonia)—Main shaft being sunk, preparatory to drifting for vein at depth.

BACA FLOAT (Tubac)—Company incorporated by A. R. Grund, of St. Louis, to work old mines on Baca Float grant, lately purchased from James W. Bouldin and Weldon Bailey.

### Yavapai County

CONGRESS CONSOLIDATED MINES (Congress Junction)—Sheriff's deed given to Attorney T. G. Norris, of Prescott, grantee, for 15 patented mines in Martinez district, five patented mines in Big Bug district, mining equipment in both sections and broad-gage railroad from Congress Junction. Judgment given last August. Congress mills now being junked.

ABE LINCOLN (Constellation)—Crosscutting on 660 level for known orebody, 180 ft. distant.

GADSDEN (Jerome)—At 1250 ft. from 1200 station is crosscutting through schist full of chalcopyrite stringers with 8-in. streak of high-grade.

JEROME VERDE (Jerome)—Maintop orebody proved to have 17 ft. of high-grade copper ore. Drifting north on this at rate of 5 ft. a day. U. V. Extension line only 30 ft. away in other direction.

UNITED VERDE EXTENSION (Jerome) About 200 ft. remains to be driven in haulage tunnel, where heading had been reduced to drift size to expedite work and the draining of mine water. Mine heading abandoned. On making connection tunnel will be enlarged, much of it concreted and track laid. Lower 250 ft. of Audrey shaft being concreted. Will also concrete entire Edith shaft. Company employing 400 men, half of normal force. Announcement of renewal of strike apparently given no attention by district workmen employed.

## CALIFORNIA

### Calaveras County

CALAVERAS COPPER (Copperopolis)—Force reduced to essential operation and development on 1200 level, the deepest working, where good ore is being mined. Treatment plant being repaired. Physical condition of mine said to be best in history.

ROYAL (Hodson)—Frank Tower and Jack Maltos extracting good ore. Expect to place old mill in operation soon.

BLACK WONDER (Westpoint)—Sold to San Francisco men. Equipped with new machinery. Motor trucks to be installed to haul ore to railroad at Valley Springs.

SAWYER (Westpoint)—To be operated under bond by Easy Bird Mining Company.

### Del Norte County

PRESTON PEAK DISTRICT attracting attention of Chicago men, said to have optioned 89 quartz-mining claims in extreme northern edge of Del Norte County and lands embracing townsite of Waldo, Ore. Much of this was held by Del Norte Claimholders' Association, which sold to Del Norte Mining Corporation, of which A. C. Ross is a principal. Railroad construction from Crescent City to tap district is considered.

OWL CHROME (Crescent City) — High-grade silver ore reported by Silas White, of French Hill district.

### Eldorado County

BIG TUNNEL SLATE (Placerville)—Optioned by Albert Bail, who is planning to develop with force of 30 men.

GEORGIA HILL (Placerville)—Optioned by San Francisco men, who will deepen workings in extensive gravel deposit. Situated in Yankee Jim district. Large producer in early days.

### Inyo County

SILVER REEF (Bishop)—Good-grade silver ore disclosed at 60-ft. depth in vein carrying shoots from 4 to 24 in. wide. Shipment of 300 sacks averaged $250 a ton.

### Kern County

BLACK HAWK (Randsburg)—Considering erection of new mill.

### Nevada County

CALIFORNIA PLACER (Nevada City)—Two hydraulic giants in operation in Missouri Canyon. Twenty men employed. Extensive area of rich placer ground developed. Tailings impounded back of barrier across canyon near Greenhorn River. Large producer in early days. J. C. Cortner, superintendent.

### Placer County

LIBERTY HILL (Dutch Flat)—Hydaulic operation started. Late storms have provided abundance of water. Holdings include Maguire mine, one of largest gravel mines in county.

### San Bernardino County

ATOLIA (Atolia)—Retimbering mine in parts. New concentrating tables being added to milling equipment.

### Santa Clara County

MAGNESITE SHIPMENTS from Western Development Co.'s property on Red Mountain to be resumed upon completion of reorganization of company. Product will be hauled by motor truck to Livermore for rail shipment.

### Shasta County

REID (Redding)—To deepen 1000-ft. shaft to 1200 ft. Ore shipped to Mammoth smeltery, at Kennett and used as flux. Series of winzes disclosed large low-grade orebodies below 1000 feet.

### Sierra County

KIRKPATRICK (Downieville) — New gravel mill installed and ready for test run. Capacity, 150 tons in 24 hours. Large amount of cemented gravel blocked out.

### Tuolumne County

DONDERO (Columbia) — To install dredge for working old placer ground at Yankee Hill.

DEL MONTE (Groveland) — To be reopened after long idleness. Shaft being retimbered and new machinery installed. H. M. Hanley, superintendent.

SHAWMUT (Shawmut)—Reported that mine will be reopened. Shut down owing to high costs.

## IDAHO

### Shoshone County

BUNKER HILL & SULLIVAN (Kellogg)—Remodeled Sweeney mill, formerly owned by Federal company, to treat large tailings dump, which averages 1½% lead. Handles 400 tons of tailings in 16 hours. Makes middling product assaying 10% lead, 4 oz. silver and 20% iron, which makes it desired by smeltery for fluxing. Second product is flotation concentrates, which assay 25% lead and 18 oz. silver.

NATIONAL (Mullan)—New orebody struck in raise from 800 level believed to be best in mine. Work suspended soon after strike was made, on account of repairs in mill, which will require probably 30 days.

HECLA (Wallace)—Leased mill, which has been handling ore from Oreornogo vein closed down. This ore carried large per cent. of zinc and was treated in another mill, Hecla mill not being equipped for its recovery. Zinc has practically disappeared from the ore and it will now be treated in company's mill at Gem.

SUCCESS (Wallace)—Company has leased all ground from 700 to 200 level and will receive 20% royalty on all lead shipments and 15% on zinc. Lessees take care of company's property and relieve it of all expense while shut down. Ground above 200 level remains under lease.

## KANSAS

### Joplin District

WACHUSETTS (P. O., Commerce, Okla.)—Will begin erection of second-hand mill soon at Treece, Kan. August Mayerhoff, manager, in charge.

COMMERCE M. AND R. (P. O., Miami, Okla.)—To begin erection soon of sludge mill near Blue Mound, Kan., to handle sand tailings at Webber mine. Capacity estimated 75 tons per shift. Will take about 30 days. John Newton, general superintendent, in charge. G. L. Coleman, general manager.

KING BRAND (P. O., Picher, Okla.) — Will start soon to open ground to erect new concentrator at Treece, Kan. Wesley Landrum, superintendent, in charge of work.

### MICHIGAN

#### Copper District

ISLE ROYALE (Houghton)—Production will be down to 60,000 tons ore per month by Apr. 1, coming from three shafts. No. 7 shaft shut down recently, and hoisting to cease in other shafts, at which work will be confined to opening up new ground. Important economy effected by stopping shipments across Portage Lake to Point Mills stamp mill and running Isle Royale mill at full capacity.

COPPER RANGE (Painesdale)—Approximate ore tonnage from three mines in February was 77,950, Champion shipping 45,700, Baltic 20,250, and Trimountain 12,000 tons.

### MINNESOTA

#### Cuyuna Range

PRELIMINARIES FOR STRIPPING in Section 19-46-29, near Riverton, completed. Winston-Deare Co., contractors, for John A. Savage interests.

BONNIE BELL (Ironton)—This property of Liberty Mining Co. shipping 6000 tons monthly high-grade non-bessemer ore direct to Zenith Furnace Co., Duluth.

#### Mesabi Range

PICKANDS MATHER (Coleraine)—Installation of concentrating machinery at Danube mine between Coleraine and Bovey progressing. Will constitute one unit with capacity of 3500 tons in 24 hours. Allis Chalmers Manufacturing Co., builders.

BOWE-BURKE (Eveleth) — Operations suspended indefinitely.

BURNS (Eveleth)—Operations reduced to one shift.

FAULT AND JEAN MINES (Eveleth)—Closed owing to lack of stockpile room. Will resume with opening of navigation.

CLEVELAND-CLIFFS (Hibbing)—Preparing to install plant at new Bourne property at Hibbing, recently leased from Great Northern Iron Ore properties.

OLIVER IRON (Hibbing)—Concreting Carson Lake shaft. Concrete starts at depth of 165 feet.

UTICA (Hibbing)—Electric pumps to be installed.

BENNETT (Keewatin)—Electric pumps to be installed.

### MISSOURI

#### Joplin District

TULSA-PITTSBURG (Waco)—Moving old Neosho-Granby mill from near Diamond, Mo., to Waco. Will take about two months. Mr. O'Connor, general manager in charge.

WOMMACK & CO. (Webb City)—Sinking shaft and erecting second-hand concentrator. Edgar Wommack, manager, in charge.

### MONTANA

#### Jefferson County

MONEY LODE (Clancey)—New equipment to be installed.

ANGELICA (Wickes)—Galena ore cut in breast of 4000-ft. tunnel, 900 ft. below surface; faulted and thrown 400 ft. to south.

LLOYD-CROSSLEY—(Wickes)—Ore cut by west drift from heading of 3000-ft. crosscut tunnel.

#### Lewis and Clark County

HELENA (Helena)—Drifting south on vein at 400 level and crosscutting west 60 ft. to contact.

TOWSLEY (Marysville)—Sinking shaft on vein.

#### Powell County

MONARCH (Elliston)—Building concentor. Large body lead-silver ore developed. Railway one mile long to be built from mine to mill.

#### Mineral County

TARBOX (Saltese)—Development warrants construction of mill, according to statement by manager. Large body milling ore developed on 800 and 1000 levels. Proposed to erect 150-ton mill if financing can be arranged.

BOSTON & MONTANA DEV. (Butte)—Work trains expected to be in operation soon over more than half of distance to Elkhorn mine on Montana Southern Ry.; passenger trains to Elkhorn by June 15. Installation of compressor plant at upper Idanha tunnel progressing. Drifting will start on body of milling ore 15-20 ft. wide.

BUTTE & SUPERIOR (Butte)—Arguments heard, beginning Mar. 19 in Supreme Court, Washington, D. C., on appeals by Minerals Separation from Federal Court opinions denying injunctions to restrain Butte & Superior from infringing on flotation patents.

TUOLUMNE COPPER (Butte)—Controversy with metal trades resulted in engineers being called off jobs at Main Range mine Mar. 20 and suspension of mining operations. Seventy men rendered idle.

### NEVADA

#### Lyon County

BLUESTONE M. AND S. (Yerington)—Mine shut down on Mar. 1 for six months, awaiting readjustment of copper situation. During shut-down mill capacity will be doubled to approximately 1000 tons per day. Flow sheet to remain unchanged, except for installation of K. & K. flotation machines. During last few months mill has made extraction of about 90%, with average ratio of concentration of 12 to 1 on 2% ore. Foregoing stated by Samuel W. Cohen, vice-president and general manager.

#### Mineral County

SIMON LEAD (Mina)—Large body of silver-lead ore being developed 23 miles east of Mina. On 300 level orebody has been developed on hanging wall for 270 ft. and a crosscut driven 76 ft. in ore. Zinc concentrated separately. Company planning 200-ton concentrator.

### OKLAHOMA

#### Joplin District

BECK (Picher)—Moving old Melrose mill from Quapaw field to Picher. Erection expected to be complete within 60 days. Mr. Beck, general manager, in charge.

### UTAH

#### Juab County

TINTIC SHIPMENTS week ended Mar. 15 were 157 cars.

COPPER LEAF (Eureka)—Suit filed by Arizona corporation against company to decide title to claims alleged to have been located in conflict with claims filed on at earlier date by complainant.

IRON KING (Eureka)—Large deposits of iron ore for fluxing to be more easily marketable with completion of Goshen Valley road to this property and Tintic Standard. Also seeking to develop extension of Tintic Standard ore zone.

TINTIC STANDARD (Eureka)—Shaft to 1450 level. Much new equipment installed and development maintained. Company largely interested in projected Goshen Valley R. R., which will furnish easier outlet to large tonnage blocked out.

#### Salt Lake County

GREATER CONSOLIDATED MINES (Alta)—Tunnel starting from Maxfield mine in Big Cottonwood proposed to cross under Cardiff over into Little Cottonwood canyon.

LITTLE COTTONWOOD TRANSPORTATION (Alta)—Narrow-gage line to Wasatch being put in condition for spring hauling after winter snows. Capacity increased by additional Shay engine, making total of three engines owned. Good shipments expected after winter of development work in mines.

SOUTH HECLA (Alta)—Week ended Mar. 15 seven cars, or 300 tons, of ore shipped. Important development work in progress in East Side workings.

OHIO COPPER (Bingham Canyon)—Operations at mine and mill suspended about Mar. 10, owing to market conditions.

#### Summit County

PARK CITY SHIPMENTS week ended Mar. 15 were 4,085,600 lb. of crude ore and concentrates.

SILVER KING COALITION (Park City)—Larger force being employed. Upper levels to be operated under leasing system.

SILVER KING CONSOLIDATED (Park City)—Better recoveries being made at new mill. Lead-silver concentrates only being shipped. Zinc held for better market.

#### Tooele County

WESTERN UTAH MINING (Wendover)—Silver-lead ore of good grade reported at this property in Silver Island district, 16 miles from Wendover, and about a mile from Gethin Le Roy, producer of limited tonnage of high-grade ore.

### WASHINGTON

#### Ferry County

LONE PINE SURPRISE (Republic)—Deeds filed at Ferry County record office on Mar. 13 conveying Lone Pine Surprise group to Northport Smelting and Refining Co. Mine and smeltery both controlled by Day interests.

#### Okanogan County

ARKINS AND GRANT (Nighthawk)—Installing 50-ton mill on property, recently bonded. All machinery purchased for present. More probably required later, but not specified.

#### Stevens County

UNITED COPPER (Chewelah) — High-grade streak of silver ore recently cut continues strong in winze being sunk from 1300 level. Lidgerwood electric hoist, capable of operating to 1000 ft., purchased and will be installed as soon as cable is received. New 15-drill compressor to be added.

LOON LAKE COPPER (Loon Lake)—Twenty-five men employed in preparing for construction of concentrator. Will double this force when construction begins.

SPOKANE COPPER (Loon Lake)—Will resume operations soon.

### CANADA

#### British Columbia

FLORENCE SILVER (Ainsworth)—Body of lead-silver ore opened up in virgin territory from No. 2 tunnel level; lies west of original body, which was stoped to surface. Distance to surface on dip is 500 ft. Downward continuation cut on fifth level 360 ft. lower down on dip. Milling resumed on two-shift basis. Will put on third shift soon.

ROSEBERY - SURPRISE (Rosebery) — Rebuilding assay office recently burned, most of contents having been saved.

SALMON-BEAR RIVER (Salmon River)—Under development by R. K. Neill, of Spokane. Shipping gold-silver ore to smeltery.

SILVERSMITH (Sandon) — Tenth-level drift reported still in oreshoot. Another carload of high-grade, making thirteen in all, ready to ship to smeltery. Shipments running about 40% lead and 90 oz. silver per ton.

GRANBY CONSOLIDATED (Vancouver)—February production of copper was 2,610,737 lb. (January, 3,156,486). Anyox plant contributed 2,072,997 lb.; Grand Forks plant 537,740 pounds.

#### Ontario

BAILEY (Cobalt)—Provided shareholders ratify proposed amalgamation with Northern Customs concentrator, work of reopening mine will be started at once after shutdown resulting from years of litigation.

FOSTER (Cobalt)—A substantial tonnage of milling ore being opened up on first level and considerable cobalt ore taken from second level.

NATIONAL (Cobalt)—Will diamond drill copper property at Temagami.

OPHIR (Cobalt)—High-grade oreshoot recently discovered only 10 ft. long; indicates promising territory. Crosscut being run on 100 level to meet vein cut on 410 level.

RIGHT OF WAY (Cobalt)—At annual meeting held at Ottawa Mar. 24 shareholders were asked to authorize issue of treasury stock at 3c. a share, proceeds to be used for development. Profits last year only $2000.

BUFFALO-KIRKLAND (Kirkland Lake)—Capital stock increased from $1,500,000 to $2,000,000.

KIRKLAND LAKE GOLD (Kirkland Lake)—New mill will be started when supplies of chemicals are received.

TOUGH OAKES (Kirkland Lake)—Mining operations resumed. Plans being prepared for connecting underground workings with those of Burnside.

MURRAY MOGRIDGE (Larder Lake)—To be reopened. Property has considerable tonnage of low-grade ore developed above 200 level.

DAVIDSON (Porcupine)—New orebody recently opened up at 500 level has been crosscut for 30 ft. without reaching foot wall. Vein throughout stated to maintain gold content.

DOME (Porcupine)—Expects to be treating 500 tons a day in May. Announcement of start of milling operations comes as surprise.

IMPERIAL (Porcupine)—Plans reorganization. Proposed to give shareholders one new share for each two now held. New stock now being offered at 10c. a share.

SCHUMACHER (Porcupine)—To be reopened and shaft sunk to 1000 level.

NICU STEEL CORPORATION (Welland)—Considering erection of ore-smelting plant and steel plant. Site and capacity not yet decided upon. At present making "Nicu" steel in plant leased by company.

#### Belgian Congo

UNION MINIERE DE HAUT KATANGA (Elisabethville)—February production of copper was 3,877,891 lb.; January, 3,306,900 pounds.

# The Market Report

SILVER AND STERLING EXCHANGE

| Mar. | Sterling Exchange | Silver New York, Cents | Silver London, Pence | Mar. | Sterling Exchange | Silver New York, Cents | Silver London, Pence |
|---|---|---|---|---|---|---|---|
| 20 | 4.7000 | 101¼ | 47⅜ | 24 | 4.6200 | 101¼ | 47⅜ |
| 21 | 4.7100 | 101¼ | 47⅜ | 25 | 4.6250 | 101¼ | 49 3/16 |
| 22 | 4.6400 | 101⅛ | 47⅛ | 26 | 4.6150 | 101⅛ | 49 3/16 |

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine.

DAILY PRICES OF METALS IN NEW YORK

| Mar. | Copper Electrolytic | Tin Spot.† | Lead N. Y. | Lead St. L. | Zinc St. L. |
|---|---|---|---|---|---|
| 20 | 14⅜ @14⅝ | 68 | 5.15 @5.25 | 4.90 @4.95 | 6.12½ @6.17½ |
| 21 | 14⅜ @14⅝ | 68 | 5.15 @5.25 | 4.90 @4.95 | 6.15 @6.20 |
| 22 | 14⅜ @15 | 68 | 5.15 @5.25 | 4.90 @4.95 | 6.15 @6.20 |
| 24 | 15 @15.10 | (a) | 5.15 @5.25 | 4.87½ @4.92½ | 6.17½ @6.22½ |
| 25 | 15 | .. | 5.15 | 4.87½ @4.92½ | 6.17½ @6.22½ |
| 26 | 15 @15.10 | (a) | 5.15 @5.25 | 4.85 @4.90 | 6.17½ @6.22½ |

(a) No quotations.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for the deliveries constituting the major markets, reduced to basis of New York, cash, except where St. Louis is the normal basing point.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other special shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for spelter are for ordinary Prime Western brands. We quote New York price at 35c. per 100 lb. above St. Louis.

†For American tin of 99% grade.

LONDON

| Mar. | Copper Standard Spot | Copper Standard 3 M. | Copper Electrolytic | Tin Spot | Tin 3 M. | Lead Spot | Lead 3 M. | Zinc Spot |
|---|---|---|---|---|---|---|---|---|
| 20 | 77 | 74½ | 82 | 238¾ | 233½ | 28 | 27 | 39 |
| 21 | 78 | 75 | 82 | 238 | 234½ | 28 | 27 | 39 |
| 22 | .... | .... | .... | .... | .... | .... | .... | .... |
| 24 | 78 | 75 | 82½ | 238 | 234½ | 28 | 27 | 38½ |
| 25 | 79 | 76 | 83 | 238 | 234¾ | 28 | 27 | 38½ |
| 26 | 79 | 77 | 83 | 240 | 236 | 28 | 27 | 39 |

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb.

## Metal Markets

**NEW YORK—Mar. 26, 1919**

The chief feature in the market this week was the development of an active demand for copper from domestic consumers, which had the effect of advancing the price a little. Lead was very dull. Zinc held firmly on the transaction of moderate business from day to day.

There is much extensive reconstruction and repair work to be done in Great Britain and elsewhere in Europe, but everything is delayed pending settlement of the peace terms and advent of industrial quietude. In France, industry is absolutely at a standstill, owing to disorganization of transport and the general financial situation, but improvement should soon become noticeable. Imports into France are prohibited, and, according to latest mail advices, there was no intention of lifting the prohibition. Quotations in France in the early part of March were as follows: Copper, 270 francs; zinc, ordinary, 140 francs; zinc, refined, 153 francs; lead, 100 francs.

**Copper**—A considerable business with domestic consumers began to develop on Mar. 20, and on Mar. 21, 22, and 24 there was some rather large business done, brass makers being buyers, among others. Up to the end of Mar. 22 the business in the main was done at 15c., delivered, 10 days, which probably averaged about 14.85c., cash, New York. There was some shading of that price on orders for deliveries to nearby works, and some business was taken on the basis of 14.75c., cash, New York. On Mar. 24, business was still done at 15c., regular terms, after which 15¼c., regular terms, was asked and received, and during the afternoon some smaller business was done at 15¼c., regular terms, equivalent to about 15.10c., cash, New York. On Mar. 26 business was done on the basis of 15@15.10c., cash, New York, but the amount was considerably less than during previous days.

We heard of only one sale for export during the week, and this was a belated acceptance. It appeared that the export business of last week was in anticipation of the decline in sterling exchange, and with the advent of that new feature orders from abroad ceased.

The domestic business of this week was largely done on the basis of new terms, formulated by one of the producers, to which the others are conforming. According to these terms, copper is sold at prices including delivery to the buyer, who is allowed 10 days from time of shipment in which to make payment if the delivery be in the territory east of Pittsburgh and Buffalo. Other times are allowed for other territories.

The arrangement between the producers and the Government for the liquidation of the stocks of copper of the latter are now practically consummated, the Government having made announcement to this effect. It remains only for the formal contract to be ratified by the producers. The arrangement will go into effect Apr. 1, after which the Government's copper will be liquidated in monthly installments spread over 15 months.

The War Department announces that an agreement has been reached for the sale of about 100,000,000 lb. of copper, in addition to copper scrap, the prices to be governed by the average published quotations in the "Engineering and Mining Journal." In a statement made public by the director of sales it is said:

"An agreement has been reached whereby the United Metal Selling Co., representing the copper producers, will sell for the War Department approximately 100,000,000 lb. of copper, and also whatever amount of copper scrap the War Department has to dispose of. Not less than 5,000,000 lb. of copper will be delivered by the United States to the copper producers each month for a period of 10 months and then 10,000,000 lb. of copper per month will be delivered for a period of 5 months.

"It was further agreed that the amounts delivered to the copper producers would be at least 10% of their total sales, and, in the event of good market conditions, the copper producers would take in excess of this amount. The copper will be sold by the copper producers at market prices as determined by the average published quotations. A small consideration will be allowed the copper producers in marketing copper for the Government to cover expenses of sales."

**Copper Sheets**—The base price of copper sheets is 22½c. per lb. Copper wire is quoted at 17½c. per lb. f.o.b. mill, carload lots.

**Tin**—On Mar. 24 American smelters were notified by Mr. Armsby to cease selling tin in lots of less than five tons. Without questioning the authority for these instructions, the smelters deferred to them, and therefore the domestic market was interrupted on that day. The demand for tin in small lots had been increasing materially. It was understood, undoubtedly, that the prevention of the filling of such orders would promote the allocation of the tin held by the U. S. Steel Products Co. that remains to be distributed. Inasmuch as smelters thought that the sooner it is done, and the sooner we have a free market, the better it will be, there was no particular use in resistance.

**Lead**—This market was extremely dull, and the amount of business that was consummated was almost negligible. The principal producer maintains an unchanged price. Other producers talk about concessions, but have not effected sales. During the last week quotations have been merely nominal, except in St. Louis, where an actual decline was registered.

London expects that the price for pig lead will settle at some point between £20 and £24. However, it is possible that the situation may be affected by interference with the Spanish production, there being a good deal of unrest in Spain.

A typographical error occurred in the lead price for Mar. 17 in last week's market report. In place of 6.15c. the figure should have been 5.15c. and the price of lead for that day 5.15@5.25c.

**Zinc**—Small business was done from day to day at prices a little firmer that those of last week, but the noteworthy feature was the sale of two lots for export to Great Britain at prices a trifle higher than what could be realized in this market, the explanation of this being that some of the cheaper sellers have no means of doing export business.

**Zinc Sheets**—The quoted price of zinc sheets is $11 per 100 pounds.

## Other Metals

**Aluminum**—Prices quoted range from 29@31c. Unchanged.

**Antimony**—It is reported that the Government is soon going to sell 1250 tons of its stock of antimony. It was probably this threat that had a depressing effect on the market, which declined to 6⅞c. for spot on Mar. 21, and closes at that figure. March-April shipments are quoted at 6⅞@6¾ cents.

**Bismuth**—Metal of the highest purity for pharmaceutical use is quoted at $3.20 per lb. for wholesale lots—500 lb. and over.

**Cadmium**—Quoted at $1.40 per lb. in lots of 500 pounds.

**Nickel**—Ingot, 40c.; shot, 43c.; electrolytic, 45c. per pound.

**Quicksilver**—Sales were reported at $67. San Franscisco telegraphs $72, steady. Reports from the mines indicate that they are not going to force things by throwing their product on the market.

## Silver and Platinum

**Silver**—The New York market remains steady at $1.01¼ for commercial silver 999 fine, but owing to the decline of London exchange, the fixed price of silver in London has advanced so as to maintain the parity between the two markets. London therefore has advanced from 47⅜d. to 49 3/16d. Exports from San Francisco during February were 27,000,000 ounces.

Mexican dollars at New York: Mar. 20, 77⅛; Mar. 21, 77⅛; Mar. 22, 77⅛; Mar. 24, 77⅛; Mar. 25, 77⅛; Mar. 26, 77⅛.

**Platinum**—Unchanged at $99@100 for refined ingot.

**Palladium**—We quote $115@125.

## Zinc and Lead Ore Markets

**Joplin, Mo., Mar. 22**—Blende, per ton, high $45.70; basis 60% zinc, premium grade, $42.50@41.50; Prime Western, $41@40; sludge, $38@37; flotation, $35; calamine, basis 40% zinc, $26@25. Average selling prices: Blende, $42.47; calamine, $31.47; all zinc ores, $42.25.

Lead, high, $65.05; basis 80% lead, $60; average selling price, all grades of lead, $59.97 per ton.

Shipments the week: Blende, 10,583; calamine, 153; lead, 2299 tons. Value, all ores the week, $591,460.

Announcement that smelters generally would reduce wages 10% the first of April was received here. Wages have been reduced at all mines, it having been done gradually, with miners concurring.

**Platteville, Wis., Mar. 22**—Blende, basis 60% zinc, $42.50 base for premium grade and $40 base for high-lead blende. No sales of lead ore are reported.

Shipments reported for the week are 1787 tons blende. For the year to date the totals are 21,388 tons blende, 979 tons galena and 73 tons sulphur ore. During the week 2412 tons blende was shipped to separating plants.

## Other Ores

**Chrome Ore**—A little more inquiry for chemical ore, particularly for Rhodesian and New Caledonian, is reported.

**Molybdenum Ore**—Business is very dull. The small lots that come up for sale by auction have an unsettling eeffct. An encouraging feature is that Great Britain is reported now to be making inquiries.

**Tungsten Ore**—The public auction that was to take place on Mar. 20 was postponed to Apr. 4. Some large lots of Chinese ore were sold at very low prices. The big holders of the stocks in this market, however, continue to stand aloof, and exhibit no nervousness.

**Pyrites**—Spanish pyrites is quoted at 17c. on the basis of 10s. ocean freight. Unchanged.

## Iron Trade Review

**PITTSBURGH—Mar. 25**

The price reductions agreed upon last week between the Industrial Board and the general committee of the iron and steel industry are regarded as effective on the morning of Friday, Mar. 21, and such shipments under old orders as would by trade practice be subject to adjustment will be adjusted according to that date. Steel for specific jobs, which brings a flat price, will not be adjusted, this including ships at a flat contract rate.

The reductions are $4.25 on pig iron and $5 on unfinished steel, per gross ton, $5 per net ton on grooved steel skelp and wire products ,and $7 per net ton on bars, shapes, plates, tubular goods, sheets, and tin plates. Rails are set at $45 for bessemer and $47 for openhearth, per net ton, $10 under the prices recommended last September by the War Industries Board, but not accepted, even as a war-time price, by the Railroad Administration. Until 1916 openhearth rails were $30, there being two $5 advances in that year.

The new prices are as follows: Bars, 2.35c.; shapes, 2.45c.; plates, 2.65c.; grooved skelp, 2.45c.; universal skelp, 2.55c.; sheared skelp, 2.65c.; steel pipe, 57½% basing discount; plain wire, 3c.; wire nails, $3.25 per keg, base; black sheets, 28 gage, 4.35c.; blue annealed sheets, 10 gage, 3.55c.; galvanized sheets, 28 gage, 5.70 cents.

**Pig Iron**—The reduction in pig iron is $4.25 per ton, and the understanding is that the War Industries Board differentials and basings are to obtain, but it is doubtful if they will in all cases. For instance, foundry iron was $1 above basic and malleable 50c. above foundry, but already there is found a furnace interest willing to sell malleable at 50c. above basic. Some furnaces insist that they will not adjust contracts to the reduced prices. There is no buying to speak of. We quote the market as follows: Bessemer, $27.95; basic, $25.75; No. 2 foundry, $26.75; malleable, $26.25; forge, $25.75, f.o.b. Valley furnaces, $1.40 freight to Pittsburgh.

**Steel**—The reduction on unfinished steel is uniformly $5 per gross ton, making prices as follows: Billets, $38.50; sheet bars and 2-inch billets, $42; slabs, $41; rods, $52, rods being Pittsburgh and the other materials Pittsburgh or Youngstown. The reduction has not brought out new buying, but has induced freer specifying on contracts, particularly in the case of sheet bars.

**Ferromanganese**—The ferromanganese market, which is made by resale material, has declined further, with 80% available at $130, delivered, though makers' quotations, purely nominal, are $200 for 80% and $176 for 70%. Spiegeleisen is to be had at $42 for 18%, shipping point, makers' quotations being $55@60, furnace.

**Coke**—The Connellsville coke market is no easier and is perhaps a shade firmer, there being less demurrage and off-grade coke offered at under $4, which is the recognized price for good grades of furnace coke. Foundry coke is available at $4.50 in fair brands, a few producers of special brands still adhering to $6. Some of the byproduct operations attached to blast-furnace plants could spare some byproduct coke, but demand is so limited that it is not worth their while to attempt to make sales.

### MONTHLY AVERAGE PRICES OF METALS

| Silver | New York | | | London | | |
|---|---|---|---|---|---|---|
| | 1917 | 1918 | 1919 | 1917 | 1918 | 1919 |
| Jan. | 75.630 | 88.702 | 101.125 | 36.682 | 44.356 | 48.438 |
| Feb. | 77.585 | 85.716 | 101.125 | 37.742 | 42.792 | 48.027 |
| Mar. | 73.861 | 88.082 | ..... | 36.410 | 43.620 | ..... |
| April | 73.875 | 95.346 | ..... | 36.963 | 47.215 | ..... |
| May | 74.745 | 99.505 | ..... | 37.940 | 48.980 | ..... |
| June | 76.971 | 99.500 | ..... | 39.065 | 48.875 | ..... |
| July | 79.010 | 99.625 | ..... | 40.110 | 48.813 | ..... |
| Aug. | 85.407 | 100.292 | ..... | 43.418 | 49.077 | ..... |
| Sept. | 100.740 | 101.125 | ..... | 50.920 | 49.500 | ..... |
| Oct. | 87.332 | 101.125 | ..... | 44.324 | 49.500 | ..... |
| Nov. | 85.891 | 101.125 | ..... | 43.584 | 48.969 | ..... |
| Dec. | 85.960 | 101.125 | ..... | 43.052 | 48.492 | ..... |
| Year | 81.417 | 96.772 | ..... | 40.851 | 47.516 | ..... |

New York quotations cents per ounce troy, 999 fine; London, pence per ounce, sterling silver, 925 fine.

| Copper | New York | | London | | | |
|---|---|---|---|---|---|---|
| | Electrolytic | | Standard | | Electrolytic | |
| | 1918 | 1919 | 1918 | 1919 | 1918 | 1919 |
| Jan. | 23.500 | (a) | 110.000 | 92.238 | 125.000 | 106.619 |
| Feb. | 23.500 | 16.763 | 110.000 | 78.700 | 125.000 | 95.700 |
| Mar. | 23.500 | ..... | 110.000 | ..... | 125.000 | ..... |
| April | 23.500 | ..... | 110.000 | ..... | 125.000 | ..... |
| May | 23.500 | ..... | 110.000 | ..... | 125.000 | ..... |
| June | 23.500 | ..... | 110.000 | ..... | 125.000 | ..... |
| July | 25.904 | ..... | 119.913 | ..... | 134.913 | ..... |
| Aug. | 26.000 | ..... | 122.000 | ..... | 137.000 | ..... |
| Sept. | 26.000 | ..... | 122.000 | ..... | 137.000 | ..... |
| Oct. | 26.000 | ..... | 122.000 | ..... | 137.000 | ..... |
| Nov. | 26.000 | ..... | 122.000 | ..... | 137.000 | ..... |
| Dec. | (a) | ..... | 118.447 | ..... | 133.167 | ..... |
| Year | 24.628 | ..... | 115.530 | ..... | 130.507 | ..... |

(a) No Market.

| Tin | New York | | London | |
|---|---|---|---|---|
| | 1918 | 1919 | 1918 | 1919 |
| January | 85.500 | 67.702 | 293.227 | 248.557 |
| February | 92.000 | 66.801 | 311.525 | 223.963 |
| March | (a) | ..... | 318.875 | ..... |
| April | (a) | ..... | 329.905 | ..... |
| May | (a) | ..... | 364.217 | ..... |
| June | (a) | ..... | 331.925 | ..... |
| July | (a) | ..... | 360.347 | ..... |
| August | (a) | ..... | 380.900 | ..... |
| September | (a) | ..... | 343.905 | ..... |
| October | (a) | ..... | 335.543 | ..... |
| November | (a) | ..... | 323.550 | ..... |
| December | (a) | ..... | 267.736 | ..... |
| Av. year | (a) | ..... | 330.138 | ..... |

(a) No average computed.

| Lead | New York | | St. Louis | | London | |
|---|---|---|---|---|---|---|
| | 1918 | 1919 | 1918 | 1919 | 1918 | 1919 |
| January | 6.782 | 5.432 | 6.684 | 5.316 | 29.00 | 37.227 |
| February | 6.973 | 5.057 | 6.899 | 4.784 | 29.00 | 28.675 |
| March | 7.201 | ..... | 7.091 | ..... | 29.00 | ..... |
| April | 6.772 | ..... | 6.701 | ..... | 29.00 | ..... |
| May | 6.818 | ..... | 6.704 | ..... | 29.00 | ..... |
| June | 7.611 | ..... | 7.511 | ..... | 29.00 | ..... |
| July | 8.033 | ..... | 7.750 | ..... | 29.00 | ..... |
| August | 8.050 | ..... | 7.750 | ..... | 29.00 | ..... |
| September | 8.050 | ..... | 7.750 | ..... | 29.00 | ..... |
| October | 8.050 | ..... | 7.750 | ..... | 29.00 | ..... |
| November | 8.050 | ..... | 7.750 | ..... | 31.20 | ..... |
| December | 6.564 | ..... | 6.324 | ..... | 40.00 | ..... |
| Year | 7.413 | ..... | 7.222 | ..... | 30.10 | ..... |

| Spelter | New York | | St. Louis | | London | |
|---|---|---|---|---|---|---|
| | 1918 | 1919 | 1918 | 1919 | 1918 | 1919 |
| January | 7.836 | 7.272 | 7.661 | 6.922 | 54.000 | 56.045 |
| February | 7.814 | 6.623 | 7.639 | 6.273 | 54.000 | 46.150 |
| March | 7.461 | ..... | 7.286 | ..... | 54.000 | ..... |
| April | 6.890 | ..... | 6.715 | ..... | 54.000 | ..... |
| May | 7.314 | ..... | 7.114 | ..... | 54.000 | ..... |
| June | 8.021 | ..... | 7.791 | ..... | 54.000 | ..... |
| July | 8.688 | ..... | 8.338 | ..... | 54.000 | ..... |
| August | 8.985 | ..... | 8.635 | ..... | 54.000 | ..... |
| September | 9.442 | ..... | 9.092 | ..... | 54.000 | ..... |
| October | 8.801 | ..... | 8.451 | ..... | 54.000 | ..... |
| November | 8.491 | ..... | 8.141 | ..... | 54.100 | ..... |
| December | 8.163 | ..... | 7.813 | ..... | 56.050 | ..... |
| Year | 8.159 | ..... | 7.890 | ..... | 54.180 | ..... |

New York and St. Louis quotations, cents per pound London, pounds sterling per long ton.

| Pig Iron Pgh. | Bessemer‡ | | Basic‡ | | No. 2 Foundry | |
|---|---|---|---|---|---|---|
| | 1918 | 1919 | 1918 | 1919 | 1918 | 1919 |
| January | $37.25 | $33.60 | $33.95 | $31.40 | $33.95 | $32.40 |
| February | 37.25 | 33.60 | 33.95 | 31.40 | 33.95 | 32.40 |
| March | 37.25 | ..... | 33.95 | ..... | 33.95 | ..... |
| April | 36.15 | ..... | 32.95 | ..... | 33.95 | ..... |
| May | 36.20 | ..... | 33.00 | ..... | 34.00 | ..... |
| June | 36.36 | ..... | 33.16 | ..... | 34.16 | ..... |
| July | 36.60 | ..... | 33.40 | ..... | 34.40 | ..... |
| August | 36.60 | ..... | 33.40 | ..... | 34.40 | ..... |
| September | 36.60 | ..... | 33.40 | ..... | 34.40 | ..... |
| October | 36.60 | ..... | 34.40 | ..... | 35.40 | ..... |
| November | 36.60 | ..... | 34.40 | ..... | 35.40 | ..... |
| December | 36.60 | ..... | 34.40 | ..... | 35.40 | ..... |
| Year | $36.67 | ..... | $33.70 | ..... | $34.45 | ..... |

‡ As reported by W. P. Snyder & Co.

### STOCK QUOTATIONS

| N. Y. EXCH.† Mar. 24 | |
|---|---|
| Alaska Gold M. | 3⅛ |
| Alaska Juneau | 2⅞ |
| Am.Sm.&Ref.,com. | 68⅞ |
| Am.Sm. & Ref., pf. | 104⅛ |
| Am.Sm.Sec., pf., A | 93 |
| Am. Zinc | 13 |
| Am. Zinc, pf. | 42⅛ |
| Anaconda | 60⅛ |
| Batopilas Min. | 1⅛ |
| Bethlehem Steel | 66⅛ |
| Butte & Superior | 21 |
| Butte Cop. & Zinc | 6⅛ |
| Cerro de Pasco | 33⅛ |
| Chile Cop. | 19⅛ |
| Chino | 34⅞ |
| Colo. Fuel & Iron | 40⅛ |
| Crucible Steel | 66 |
| Crucible Steel, pf. | 94 |
| Dome Mines | 12⅛ |
| Federal M. & S. | 10 |
| Federal M. & S., pf. | 36⅛ |
| Great Nor., ore ctf. | 41 |
| Greene Cananea | 42⅛ |
| Gulf States Steel | 53⅞ |
| Homestake | 98 |
| Inspiration Con. | 46⅞ |
| International Nickel | 25⅞ |
| Kennecott | 31⅛ |
| Lackawanna Steel | 69⅛ |
| Mexican Petrol. | 180 |
| Miami Copper | 22⅞ |
| Nat'l Lead, com. | 66⅛ |
| National Lead, pf. | 106⅛ |
| Nev. Consol. | 16 |
| Ontario Min. | 6⅛ |
| Ray Con. | 20 |
| Republic I.&S.,com. | 81⅞ |
| Republic I.&S., pf. | 103 |
| Sloss-Sheffield | 53 |
| Tennessee C. & C. | 12⅛ |
| U. S. Steel, com. | 97⅛ |
| U. S. Steel, pf. | 115 |
| Utah Copper | 72⅛ |
| Va. Iron C. & C. | 56 |
| Worthington Pump | 62 |

| BOSTON CURB* Mar. 25 | |
|---|---|
| Alaska Mines Corp. | ‡.12 |
| Boston Ely | .99 |
| Boston & Mont. | .53 |
| Butte & Lon'n Dev. | .11 |
| Calaveras | 1 |
| Chief Con | 3⅛ |
| Contact | .05 |
| Corbin | ‡.25 |
| Cortez | .12 |
| Crown Reserve | .50 |
| Crystal Cop. | .27 |
| Eagle & Blue Bell | 2⅛ |
| First Nat. Cop. | 1⅛ |
| Houghton Copper | .15 |
| Intermountain | ‡.05 |
| Iron Blossom | .40 |
| Iron Cap | 9⅛ |
| Majestic | .16 |
| Mexican Metals | .23 |
| Mines of America | ‡.05 |
| Mojave Tungsten | .03 |
| Nat. Zinc & Lead | .08 |
| Nevada-Douglas | .15 |
| New Baltic | 1 |
| Oneco | .20 |
| Pacific Mines | ‡.35 |
| Rex Cons. | .05 |
| Yukon Gold | .75 |

| SAN FRAN.* Mar. 18 | |
|---|---|
| Alta | .01 |
| Andes | .07 |
| Best & Belcher | .04 |
| Caledonia | .05 |
| Challenge Con. | ‡.03 |
| Confidence | ‡.03 |
| Con. Virginia | .19 |
| Gould & Curry | .02 |
| Hale & Norcross | .19 |
| Jacket-Cr. Pt. | .04 |
| Mexican | .14 |
| Occidental | .40 |
| Ophir | .27 |
| Overman | .01 |
| Savage | .09 |
| Sierra Nevada | .05 |
| Union Con. | .16 |
| Utah Con. | ‡.02 |
| Belmont | 3.50 |
| Jim Butler | .35 |
| MacNamara | .49 |
| Midway | .31 |
| Mont.-Tonopah | .15 |
| North Star | .07 |
| Rescue Eula | .08 |
| West End Con. | 1.05 |
| Atlanta | .05 |
| Booth | .14 |
| Comb. Frac. | ‡.02 |
| Florence | .34 |
| Jumbo Extension | .13 |
| Kewanas | .05 |
| Nevada Hills | .02 |
| Nevada Packard | .20 |
| Round Mountain | .43 |
| Silver Pick | .06 |
| White Caps | .15 |

| COLO. SPRINGS* Mar. 18 | |
|---|---|
| Cresson Con. | 4.75 |
| Doctor Jack Pot | .04 |
| Elkton Con. | .06⅛ |
| El Paso | .15 |
| Gold Sovereign | ‡.02 |
| Golden Cycle | ‡.79½ |
| Granite | .14 |
| Isabella | .05½ |
| Mary McKinney | .06 |
| Portland | .75 |
| United Gold M. | .14⅛ |
| Vindicator | .41 |

| BOSTON EXCH.† Mar. 25 | |
|---|---|
| Adventure | ‡.75 |
| Ahmeek | 64 |
| Algomah | ‡.30 |
| Allouez | 36 |
| Ariz. Com. | 11⅛ |
| Arnold | ‡.20 |
| Bingham Mines | ‡8⅛ |
| Bonanza | ‡.10 |
| Butte-Balaklava | ‡.22 |
| Calumet & Ariz. | ‡59⅛ |
| Calumet & Hecla | 400 |
| Centennial | 12⅛ |
| Copper Range | 41⅛ |
| Daly West | ‡3 |
| Davis-Daly | 5 |
| East Butte | 8⅛ |
| Franklin | ‡3⅛ |
| Granby | ‡70 |
| Hancock | ‡5⅛ |
| Hedley | ‡12 |
| Helvetia | 25 |
| Indiana | ‡.75 |
| Isle Royale | 24⅛ |
| Keweenaw | ‡.99 |
| Lake | ‡3⅛ |
| La Salle | 2 |
| Mason Valley | ‡2⅛ |
| Mass | 4 |
| Mayflower | 3⅛ |
| Michigan | ‡2⅛ |
| Mohawk | 53 |
| New Cornelia | ‡1⅛ |
| New Arcadian | 15⅛ |
| New Idria | ‡9⅛ |
| North Butte | 10 |
| North Lake | ‡.50 |
| Ojibway | ‡1⅛ |
| Old Dominion | ‡32 |
| Osceola | 45⅛ |
| Quincy | 52 |
| St. Mary's M. L. | 40 |
| Santa Fe | ‡.25 |
| Seneca | 13⅛ |
| Shannon | 2 |
| Shattuck-Ariz. | ‡14⅛ |
| So. Lake | 11 |
| So. Utah | ‡.14 |
| Superior | 4⅛ |
| Superior & Bost. | 1⅛ |
| Trinity | 2⅛ |
| Tuolumne | ‡.82 |
| U. S. Smelting | 48⅛ |
| U. S. Smelting, pf. | 47⅛ |
| Utah Apex | 2⅞ |
| Utah Con. | 8 |
| Utah Metal | 1⅛ |
| Victoria | 1⅛ |
| Winona | ‡.90 |
| Wolverine | 16⅛ |

| N. Y. CURB† Mar. 24 | |
|---|---|
| Big Ledge | .50 |
| Butte & N. Y. | ‡.50 |
| Butte Detroit | ‡.05 |
| Caledonia | .31 |
| Calumet & Jerome | 1⅛ |
| Can. Cop. Corpn. | 1⅛ |
| Carlisle | ‡2 |
| Cashboy | .13 |
| Con. Ariz. Sm. | 1⅛ |
| Con. Coppermines | ‡5 |
| Goldfield Con. | .18 |
| Goldfield Merger | .06 |
| Greenmonster | ‡⅛ |
| Hecla Min. | ‡44⅛ |
| Howe Sound | ‡3⅛ |
| Jerome Verde | ‡.75 |
| Louisiana | .25 |
| Magma | ‡27 |
| Marsh | ‡.03 |
| McKinley-Dar-Sa. | ‡.47 |
| Milford | ‡.75 |
| Mother Lode | .36 |
| Nixon Nevada | ‡.40 |
| Ohio Cop. | ⅛ |
| Rawley | ‡2⅛ |
| Ray Hercules | 2⅛ |
| Richmond | ‡.56 |
| Rochester Mines | .23 |
| St. Joseph Lead | 11 |
| Standard S. L. | 1 |
| Stewart | .15 |
| Success | ‡.05 |
| Tonopah | ‡3⅛ |
| Tonopah Ex. | 2⅛ |
| Tribullion | ‡⅛ |
| Troy Arizona | ‡.10 |
| United Eastern | ‡4⅛ |
| United Verde Ext. | ‡32⅛ |
| United Zinc | ‡⅛ |
| Utica Mines | ‡.08 |

| TORONTO* Mar. 18 | |
|---|---|
| Adanac | .20 |
| Bailey | .04 |
| Beaver Con. | .41 |
| Chambers Ferland | .10 |
| Coniagas | 2.25 |
| Hargraves | .02 |
| Kerr Lake | ‡5.12½ |
| La Rose | ‡.31½ |
| Lake Shore | ‡.91 |
| Min. Corp. of Can. | 2.00 |
| Nipissing | ‡8.75 |
| Peterson Lake | .08 |
| Temiskaming | .31 |
| Wettlaufer-Lor. | ‡.03 |
| Davidson | .65 |
| Dome Exten. | .27 |
| Dome Lake | .24 |
| Mollinger | 5.12½ |
| McIntyre | .68⅛ |
| Newray | .08 |
| Pocu. Crown | .27 |
| Teck-Hughes | .25 |
| Vipond | .22 |
| West Dome | .13 |

* Bid prices. † Closing prices. ‡ Closing quoations.